USER COMMUNICATION NETWORKS AND NEEDS

INPUT

ABOUT INPUT

THE COMPANY

INPUT provides planning information, analysis, and recommendations to managers and executives in the information processing industries. Through market research, technology forecasting, and competitive analysis, INPUT supports client managem... in making informed ... services are provided ... of computers, commu... products and services.

The company carries o... depth research. W... clients on important ... members analyze and ... data, then develop ... innovative ideas to ... Clients receive re... access to data on whic... and continuous consult...

Many of INPUT's profe... have nearly 20 years ... areas of specializatio... senior management po... marketing, or planni... enables INPUT to sup... to complex business pr...

Formed in 1974, IN... leading internationa... Clients include over ... largest and most ... companies.

UNITED STATES, West Coast
2471 East Bayshore Road
Suite 600
Palo Alto, California 94303
(415) 493-1600
Telex 171407

...ty Way

...alifornia 90291

...st Coast

...ersey 07662

...loor)

...Merriwa Street
...N.S.W. 2072

Milan 284-2850

JAPAN
INPUT Japan
Suite 1106
7-7-26 Nishi-Shinjuku
Tokyo
Japan 160
(03) 371-3082

USER COMMUNICATION NETWORKS AND NEEDS

A MULTICLIENT STUDY

NOVEMBER 1980

USER COMMUNICATION NETWORKS AND NEEDS

TABLE OF CONTENTS

			Page
	B.	Intercompany Relations	37
	C.	Industry Groups	38
		1. ABA Bank Network Feasibility Study	39
	D.	Traffic Volumes	41
	E.	Network Management	42
		1. Network Monitoring	42
		2. Diagnostics	45
		3. Remote Test Control	45
		4. Network Control	46
		5. Network Performance Measurements	47
		6. Network Performance Standards	48
		7. Network Performance Analyses	48
	F.	Local Networks	49
		1. Two Classes Of Local Networks	50
		2. Local Network Applications	51
	G.	Network Geography	54
		1. Geography Of User Operations	55
		2. Geographic Spread	56
		3. Multiple Locations In The Same City	59
IV		STATUS OF USERS' EXISTING COMMUNICATION NETWORKS	63
	A.	Definition Of A Network	63
	B.	Use Of Communications Networks	64
	C.	Network Configurations	66
	D.	The Elements Of A Network	70
	E.	Voice Networks	72
		1. Network Switching	72
		2. PBX	77
		3. Other Voice Network Issues	80
	F.	Data Networks	83
		1. Numbers Of Networks	83
		2. IBM And The Other Computer Vendors	83
		3. Types Of Networks	87
		4. Terminals	91
	G.	Message Networks	91
	H.	Facsimile Networks	94
	I.	Intercompany Communication Application	97
		1. Intercompany Message Communication Applications	97
		2. Intercompany Data Communication Applications	97
	J.	Network Management Capabilities	99
V		FORECASTS OF CHANGES IN USERS' COMMUNICATION NETWORKS	101
	A.	The Agents Of Change	101
		1. New Applications (Change Factor = Corporate)	103
		2. New Corporate Organization (Change Factor = Corporate)	103
		3. Changes In Corporate Strategy/Policy (Change Factor = Corporate)	104
		4. Cost Improvement (Change Factor = Plan)	104

Page

Page

INPUT

USER COMMUNICATION NETWORKS AND NEEDS

LIST OF EXHIBITS

I INTRODUCTION

I INTRODUCTION

A. OBJECTIVES

- The primary objective of this study is to identify and quantify the implications of change on users' communications networks, specifically those of the Fortune 500/50 companies.

- Other subobjectives of the study are to:

  - Identify business opportunities to provide communications products and services to large companies.

  - Determine what equipment is connected to the communication networks used by these large companies.

  - Estimate how these uses and equipment have changed since INPUT examined this same market in its 1977 study, "Value Added Network Services."

  - Estimate how these large network uses will change by 1985.

  - Evaluate the network users' needs for communications products and services and the features of such products and services.

- Consider the users' requirements for services specifically needed to implement intercompany communications.

- Estimate and analyze probable actions of the key vendors that can affect this marketplace.

- Determine the role of computer services vendors in this communications market.

- Determine how the purchasing process to obtain communications products and services is conducted.

- Recommend marketing and sales strategies to use in the sale of products and services to this marketplace.

B. METHODOLOGY

I. THE USER SURVEY

- The primary source of information for this project was an extensive set of user interviews with both the voice communication manager and the data communication manager in large companies.

- Large companies are defined as the Fortune 500 list of the largest manufacturers and the six lists of the Fortune 50 largest non-manufacturing companies. These Fortune 50 lists included banking, diversified financial, insurance, transportation, utilities and retailers.

- INPUT conducted interviews with 150 such companies, as shown in Appendix F. In over half of the companies, two interviews were conducted. In the other half, only one was conducted.

- In 67 of the interviews, the discussion was conducted on-site with the respondent. The remainder of the interviews were conducted by telephone.

- Information obtained from the interviewed companies included, in a large number of cases, network maps and directories, recent internal studies performed and, frequently, guided tours of switching and control centers.

- In addition to the interview program, a literature research study was conducted on each of the companies interviewed, using such sources as magazine articles, computer installation census reports, annual reports and 10K reports as well as interviews conduced by INPUT with those companies for other studies.

- A very comprehensive questionnaire was used in order to elicit a broad response concerning the relative importance of all elements of those networks. This questionnaire is shown in Appendix F.

- The interviews were conducted by a team of five individuals with professional experience averaging approximately 20 years.

- At the conclusion of the user interview program and the associated literature research, the results were codified and computerized for analysis.

- In addition, a set of reports was obtained from the Dun and Bradstreet Marketing File giving operating locations and employment figures for most of the companies interviewed during the study. These data were then analyzed and resolved into the geographic data on the Fortune company market.

- Approximately two-thirds of the companies interviewed had been previously interviewed for the 1977 study, "Value Added Network Services." The interviews with these companies were checked for consistency and also to establish and/or confirm growth rates in certain areas.

- It should be noted that the VAN study dealt primarily with expenditures and users' needs for value added functions. This study deliberately addressed other network areas, primarily network status and planned changes.

2. THE VENDOR SURVEY

- Interviews were conducted with a total of 42 vendors and related external organizations. For the most part, these are companies providing leading-edge equipment and/or services.

- The intent of the interview was to develop an understanding of the probable impact of the subject, product or service on the networks of the large companies.

- A specific questionnaire was not designed for the vendor interviews since each vendor was interviewed on a specific topic uniquely related to that vendor. However, an outline used in these vendor discussions is shown in Appendix F.

3. QUALIFICATION OF RESULTS

- As with most questionnaires, the results of the interviews ranged from extremely good to barely acceptable.

  - Since the questionnaire was designed to be both redundant in some of its questions (in order to qualify various responses) and at the same time very comprehensive, it was not the intent to have all questions answered by all respondents. The questions regarded as essential are shown with an asterisk on the questionnaire. These key questions were answered by at least two-thirds of the respondents in all cases.

- In order to provide users of this study with a more qualified set of data from which to draw their own conclusions, most of the data shown in the following text and exhibits incorporate a statement of the number of valid responses. In

some cases, especially in the Fortune 50 categories, the number of valid responses makes the conclusion suspect. The results in these cases should therefore be used as an indicator and not as a basis for any further extrapolation.

- The overall sample tends to be slightly biased on the side of larger companies. However, 94 of the interviews were obtained from the Fortune 100 to 500 companies and each of the Fortune 10 to 50 industries.

- In the case of some very large conglomerate firms (some of them classified as diversified financial companies and others classified as manufacturers in the Fortune definitions), it was not possible to interview the Fortune entity itself but rather one of its major subsidiaries or subsidiary groups. This was true at five of the 150 companies interviewed.

- Conversely, within the other Fortune entities there often exist subsidiary firms that are not an inherent part of the parent entities' corporate communication networks. These also tended to be eliminated from the information obtained.

- The networks examined were strictly domestic. Many of the firms interviewed had substantial amounts of international revenue and employment. For the most part, these were removed from the data prior to the analysis of these companies' networks.

- A final qualifier is that many companies, particularly the large aircraft and auto companies, have data processing organizations established as subsidiary companies providing data processing and network services both to the parent and to outside organizations. Rather than attempt to remove these service operations from the basic corporate entity, an attempt was made to correct for them by treating their entire operation as a basic part of the corporate communication network.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

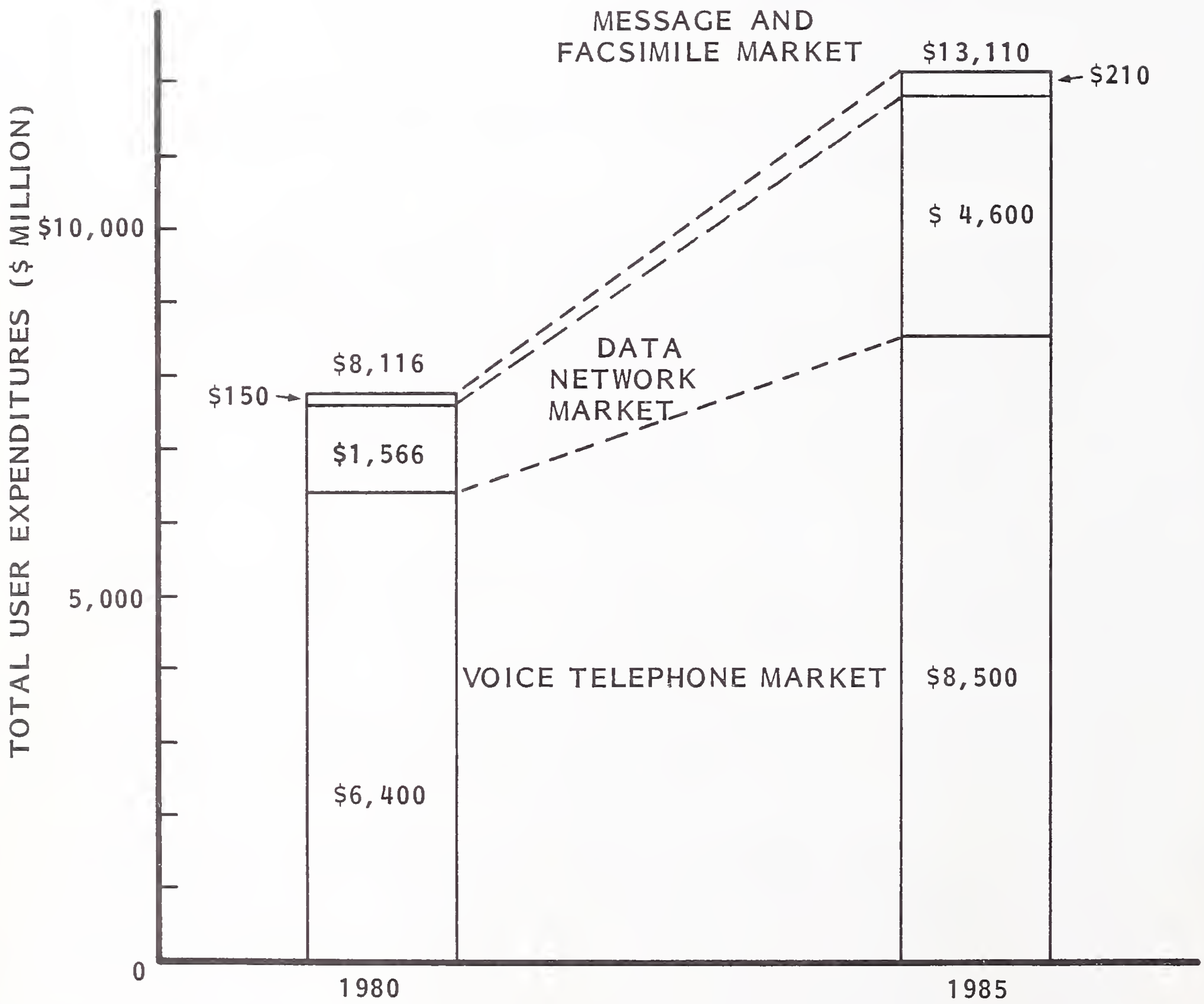
A. MAJOR CONCLUSIONS

1. EIGHT BILLION DOLLAR MARKET GROWING TO THIRTEEN BILLION DOLLARS BY 1985

- The portion of the communication market composed of large (Fortune 500/50) companies represents almost $8 billion per year, or 40% of the total business communications market, as shown in Exhibit II-1.
  - This estimate is, if anything, conservative by reason of understated local telephone service costs.
- This large company market is changing at a higher rate than most other major segments of the communication market.
  - These changes include high growth in some segments of the market as well as high levels of equipment upgrades in other segments.
- Within this market, significant business opportunities are regularly created and/or exposed.

EXHIBIT II-1

MARKET SIZE ESTIMATE - FORTUNE 500/50
TOTAL COMMUNICATIONS NETWORK MARKET



2. DOMINATED BY AT&T AND IBM

- Historically this market has been the domain of the giants of the information industry, particularly AT&T and IBM, as shown in Exhibit II-2.

  - AT&T controls about 75% of the revenue from this market.

  - IBM, even though its communications-related revenue (front-end communications processors to terminals) is only 4%, controls through its computer installations about 75% of all data communications.

  - Every Fortune 500/50 company is a large customer of AT&T and 95% of them are customers of IBM.

- However, there are visible signs that, among the largest and most sophisticated companies - the leading-edge user - there is a growing undercurrent of dissatisfaction with the standard offerings of the giant suppliers.

3. INCREASING SHARE OF MARKET AVAILABLE

- That portion of the market not dominated by AT&T and IBM is highly available. There is no other dominant company in the communications industry.

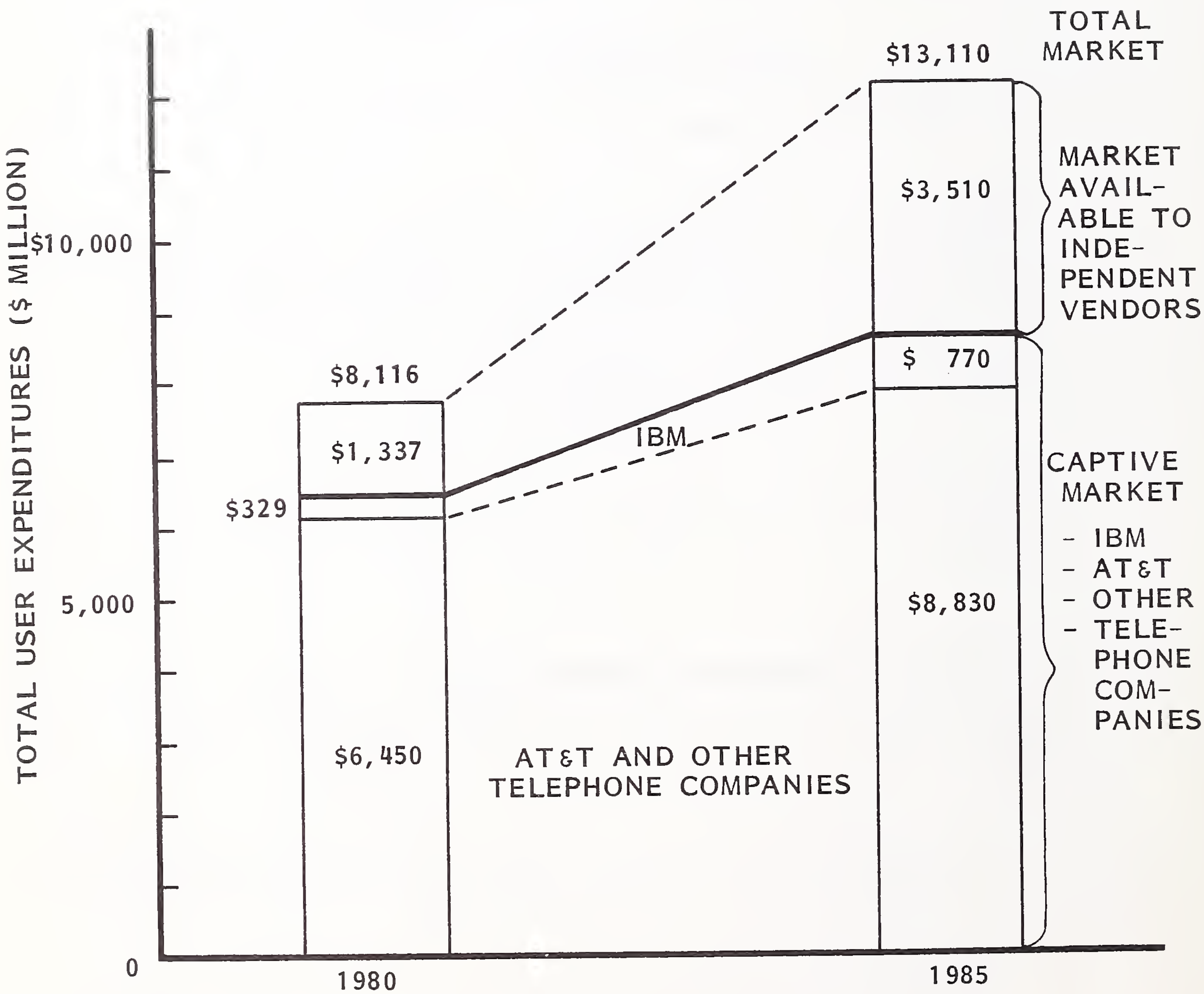
- As shown in Exhibit II-2, the available portion of the market is growing more rapidly than the captive market (23% AAGR versus 10% AAGR). This is because:

  - It includes most of the new high-growth segments such as facsimile equipment, communication processors, etc.

  - Alternatives to AT&T and IBM products in the older segments are becoming available from other vendors.

EXHIBIT II-2

MARKET SIZE ESTIMATE - FORTUNE 500/50
TOTAL COMMUNICATIONS NETWORK MARKET



- Within this available market, many significant business opportunities exist and many more are unfolding.

4. GROUP OF LEADING-EDGE USERS

- Leading-edge users, with a growing recognition of the need to control their own networks, are increasingly looking for alternatives to the standard offerings.

- These leading-edge users are at present a small fraction, perhaps 5%, of the Fortune 500/50 firms.

- The leading-edge users tend to come from a limited number of industry segments:

    - Oil companies.

    - Aircraft manufacturers.

    - Electronics firms.

    - Banking.

- There are few other firms that could be regarded as leading-edge users. Generally these others are not the largest in their industries.

- Some companies tend to be leading-edge users in specific areas of communication such as teleconferencing, satellite transmission, electronic mail, etc.

- The majority of the other companies within this large-company market operate within the more standard framework, and the resulting business opportunities, while large, are closely related to the standard.

5. PRIMARY KEY TO THE MARKET: PROVIDING USER CONTROLS

- The driving force behind most of the network changes is the users' desire for control. Control includes network management, cost stability, maintenance control, user access control, etc.

  - A major result of these changes is that the fastest-selling products in the market incorporate network control capabilities. These include call detail recording systems in voice networks and centralized network control systems in data networks.

- User control means something slightly different in each type of network.

  - In voice networks: traffic knowledge and control of service delivery.

  - In data networks: network reliability and control of service delivery.

  - In message networks: responsibility for the networks.

  - In facsimile networks: responsibility for the devices and the networks.

  - In electronic mail systems: responsibility for the system design.

- Cost reduction, a very common driving force in communication networks, particularly in the voice and message area, is <u>not</u> a primary factor for these companies.

- Technology is only an indirect factor. Technology impacts the users' network changes in terms of allowing their requirements to be met. Technology also provides the vendors with a "talking tool." Good examples of this latter point can be seen in the marketing of PBX equipment, where "digital switching" and "data compatibility" are major selling tools for the PBX manufacturers.

6. LOCAL LOOPS: MAJOR OBSTACLE

- By far, the greatest obstacle to the efficient implementation of networks, voice, data or other, is the very limited availability of local loops, particularly high-speed local loops.

  - In the case of local loops, the only practical alternative available today is the telephone company.

  - All of the other elements of a network (long-distance transmission switching equipment, terminal equipment and inside wiring) are capabilities reasonably available. In addition, practical alternatives are becoming more available.

- This obstacle is a particular problem for companies with multiple large operations in the same city. Within the Fortune 500/50 market, there are estimated to be almost one thousand such proximately located operations with more than 1,000 employees each.

  - New technology, particularly radio-based, is likely to take a long time to implement.

B. OTHER CONCLUSIONS

1. VOICE NETWORKS

- Not all the Fortune 500/50 companies included in this study have a corporate voice network. About 25% of the companies have distributed or completely autonomous organizations, each with its own separate voice network and little or no organized connection with the corporation. These "non-network" companies for the most part had no plan to make changes that would create a corporate network.

- Of the remaining 75% of the companies with corporate networks, more than half were planning to make substantial changes at the top level of their networks.

- The reason for most of these changes is that users now see in new network products an opportunity to gain control over additional key aspects of their networks. These points of control include the following:

  - Budget control by means of call detail recording for cost allocation to users and for network optimization studies.

  - Cost control by incorporating into the network enough flexibility to allow the network manager to make changes to compensate for anticipated increases in the cost of long-distance facilities. These include features such as simple trunk rearrangements, call queue, etc.

- Growth in the voice network segment of the Fortune 500/50 network market is characterized primarily by changes in the types of switching equipment. Growth rates of total installations are relatively low (about 5%).

2. DATA NETWORKS

- Ninety-five percent (95%) of the companies interviewed have at least one data network and 70% of the companies have more than one data network.

  - The average for the sample is 3.8 data networks per company.

- Many of these networks were not corporatewide, but rather served a specific division or geographic area of the company.

- There is strong pressure building to integrate these networks into a single network, or at least a reduced number of networks. This pressure derives from management's perceived need for:

- Cost control.

- Network operations control.

- A broader spectrum of network-attached equipment.

* This last point best illustrates the users' perception of data networking capability likely to be available in the near future.

* Approximately half of the companies are either implementing or planning to implement changes in their corporate data networks, most of which are oriented toward integrating these networks.

* About 90% of the large companies have on-line interactive data communication networks. The remainder have only RJE or some other form of batch data communication network.

  - The network will be able to interface not only with multiple systems (sets of applications) but also with a wider range of devices that were previously incompatible by reason of speed, code, traffic pattern, etc.

* Of the 70% that have two or more data networks, most have both batch and interactive in operation.

* The networks planned by these large companies can be classified into two types:

  - Data processing center-oriented networks, usually using SNA.

  - Host-independent data communications networks, usually using packet-switching technology.

- The companies implementing independent data communication networks tend to be the most sophisticated in terms of both qualified data communications staff and multiple computer vendor installations.

  - Most, but not all, would be categorized as leading-edge users.

- Users generally expect little change in terminals other than a rapid increase in their numbers. To the extent that intelligence is added to the capability, they expect it to reside more in the network than in the terminals.

  - One major exception is in batch terminals, which users are expanding from simple, high-speed reader/printers to processing nodes with their own peripherals. The distinction between a batch or media terminal and a distributed processor is blurring.

- Networks are required to handle many different data traffic patterns, depending on the types of devices connected to the network.

  - Traffic volume from connected devices ranges from 10,000 to one million characters per day per device.

  - Traffic volume per network ranges from 200,000 to 700 million characters per day.

- An area currently receiving major consideration from the users is network management. As users move into a reduced number of major network centers or independent networks, both the requirement for, and the economic feasibility of, a sophisticated network management system becomes real.

  - This is an area where many users' requirements are well ahead of the available products.

- Growth in the data network segment of the Fortune 500/50 network market is characterized primarily by growth in the number of installed units (about 20%).

3. MESSAGE NETWORKS

- Most of the major companies have message communications systems, often including a freestanding message switcher. In some cases these systems are quite large (up into the hundreds of terminals).

- These message networks are, however, in the process of migrating to other means, particularly in terms of integration into the data networks.

- The primary long-term applications that can be expected to remain in message systems are those with interfaces with external companies and international companies.

- Growth in this segment is actually negative in terms of total installations.

4. FACSIMILE NETWORKS

- Most of the companies interviewed had facsimile devices installed. In a few cases the number of devices was considerable (into the hundreds).

  - The networks were almost exclusively manually controlled by the end users.

  - The transmission media used was, with few exceptions, the voice telephone network.

- The communication managers generally knew the status of facsimile installations (i.e., the numbers and types of equipment installed). However, the purchase decision had been made by another organization within the company. A major effort is under way in most organizations to gain control of the

facsimile networks by the communications manager. Hence there was little or no effort to integrate facsimile into other corporate networks.

- Growth in the facsimile segment is due to a rapid growth of installations of the higher-speed (two-minute and one-minute) devices.

- The primary future requirement expressed by respondents in the area of facsimile was higher speed. In a few cases the respondent was also looking for value added features, particularly automated operation or store and forward.

5. ELECTRONIC MAIL

- A small number of companies has implemented electronic mail systems. In these cases, however, the user group is typically a specific department such as sales or engineering. There were three cases where a corporatewide electronic mail system was being installed.

- The companies that have implemented an electronic mail system are generally either:

  - Companies with a vested interest in electronic mail, such as computer companies or office product manufacturers.

  - Companies with extensive and distributed technical groups.

- The term electronic mail was surprisingly well understood by the respondents to describe a form of managed message communications between keyboard-capable devices.

- Electronic mail is definitely being studied by most companies as part of an office automation task force.

- However, while these studies are progressing (usually very slowly), many of the user groups have established their own electronic mail capability.

- One major expectation is that many remote computing service organizations will be entering this electronic mail market with comprehensive new services.

- Growth in the electronic mail segment is potential growth in terms of the number of companies (or groups within companies) implementing new electronic mail systems.

6. TELECONFERENCING

- To most respondents, the term teleconferencing meant some form of video conferencing. Computer-aided teleconferencing was not a familiar technique to most of the respondents.

- Video conferencing is being watched closely by large companies, but for the most part is still regarded as too expensive.

- Two companies in the interview sample are in the process of testing the AT&T Picturephone meeting service, including having their own on-site facilities as well as the more common use of Bell's facilities in seven cities. While none of these companies was dissatisfied with the results of their experience, none had come to any firm conclusions about further use of this service or of anything else comparable.

- Some companies that have implemented satellite earth stations are using these transmission facilities to implement slow-scan video conferencing. In these cases the transmission link was installed for other purposes, usually RJE applications, and a slow-scan video capability was installed later, more or less as an experiment. The companies were apparently surprised by the relatively high level of acceptance of slow-scan video conferencing uses by specialized groups, primarily engineers, within their company.

7. DRIVING FORCES FOR CHANGE

- The single most direct force for change within major company communication networks is an organizational change within the company (such as an acquisition) or a change in corporate policy (such as the method or place of customer contact).

- Another significant driving force is the physical movement of organizational entities within the corporation. No less than 8% of the the companies interviewed were in the process of moving their corporate headquarters to different buildings.

- User-created driving forces tend to focus on existing applications or on situations where the user recognizes a requirement to perform a function better.

  - An obvious requirement originated by users is the need for high-speed communication between closely located buildings.

- Vendor-created driving forces tend to focus on new applications or on new methods for performing functions within the networks. An example of this is electronic mail, which is very definitely a vendor-driven application.

C. IDENTIFIED BUSINESS OPPORTUNITIES

1. MARKET OPPORTUNITIES

- Dealer Networks. Those companies with extensive dealer/distributor operations, such as automobile manufacturers, airline companies (travel agents), insurance companies, etc., have a major requirement to communicate with dealers. In many cases the requirement is presently being met, at least partially. But in all cases, met or not, changes in relationships and in dealer-located equipment dictate a new type of network capability.

- There are perhaps 1,000 such dealer networks potentially possible within the Fortune 500/50 market, about 100 of which were identified in this study. Some of these are known to be $10 million/year networks.

- Industry Groups. Many industry groups or trade associations (such those as in banking, airlines, railroads, retailers, etc.) are not only becoming involved in research and consulting-type services for their members, but are also establishing communication networks to serve their industries. These groups represent large new potential customers as well as focal points for developing an understanding of industry requirements.

  - Some 50 different industry groups are capable of being the focal point of an industry communication network. ARINC, for example, is a $100+ million per year operation.

- Electronic Mail. Although an organized market for electronic mail does not yet exist in terms of defined customers, product patterns or strategy, the fact that end users in large companies are establishing their own capabilities leads very clearly to the conclusion that there is a sizable market opportunity.

  - This opportunity might be addressed as either a service offering (Telemail, On-Tyme, Comet, etc.) or as a hardware or software product.

  - Initially there are between five and fifty groups of ten or more people in each of the Fortune 500/50 companies that are electronic mail prospects. These include engineering teams, sales departments, legal departments, product development projects, market research projects, etc.

2. SYSTEM OPPORTUNITIES

- Network Management Systems. Relatively few companies have implemented any kind of full-scale network management system, but most are heading in that direction.

- In voice networks, a network management system would be a combination automated trunk monitoring system and traffic analyzer.

- In data networks, a network management system would be an automated network control system and a system performance analyzer.

- The ultimate market for network management systems among the Fortune 500/50 companies is about 2,000 systems at a cost of $1 million each.

- Facsimile Network Management Systems. In most facsimile networks there is effectively no control at all. All of the functions to which data and voice network users have grown accustomed, such as automatic route selection, call queuing, message forwarding, unattended operation and multidevice access compatibility, are missing from facsimile networks.

  - Furthermore, these networks exhibit rapid growth accompanied by a strong desire on the part of communications managers to establish control.

  - Network management systems for facsimile are a possible future step.

  - Facsimile control networks, either hardware- or service-based and either with or without transmission capabilities, represent a potential of up to $200 million per year.

- Local Loop Solutions. As noted in a number of places in this report, the local transmission facility between the user's building and the nearest carrier office as an immense bottleneck to efficient network implementation. This limitation becomes acute in two situations:

  - Wideband data transmission requirements.

- Multiple large buildings of the same company within the same city.

- Users have gone to tremendous lengths to solve this problem using digital microwave, CATV, FM radio, infrared or laser links, etc. Many industry suppliers are addressing the problem (including the telephone companies), but a clear solution is not yet visible.

  - Local loop costs, although not broken out from LD transmission, represent a user expenditure to the telephone companies of about $2 billion per year.

3. PRODUCT OPPORTUNITIES

- Host-Independent Network Equipment. In spite of the huge inroads IBM has made (and is continuing to make) in this large-company marketplace, with its SNA-based network solutions, the long-term trend appears to be a host-independent data network. This trend results from the growing array of devices and facilities that both comprise and are attached to the data network, and also from the growing varieties of traffic patterns and control requirements imposed.

  - The opportunity today is to sell equipment and subsystems to a very limited number of leading-edge users. As the number of users and the size of the business opportunity grows, so also will the competition, particularly from IBM.

  - As shown in Exhibits VIII-10 and VIII-11, the available communication processor market is $52 million in 1980, growing to $100 million in 1985.

- Batch Terminals. One of the fastest-growing areas in this marketplace is batch terminals. The terminals described are not simply 2780 replacements, although similar communication protocols will be used. Rather, they are local terminal controllers with multiple terminals, an extensive amount of terminal

support intelligence and buffering, and a number of communication ports, the main one of which is to the data network.

- As shown in Exhibits VIII-10 and VIII-11, the media terminal market is $300 million in 1980, growing to $1,275 million in 1985.

- Intelligent Telephones. While most business telephones in large companies are sold by the carrier or the PBX provider, a growing acceptance of connection standards have opened the market for other companies to provide telephone instruments independently. These intelligent telephones can perform many of the functions that might otherwise be handled by the PBX, such as automatic answering, speed calling, call progress display, caller identification display (in an AIOD system), function code generation, data and dictation interfaces, etc. These telephones may be configured by software to meet the specialized requirements of various employee workstations.

  - The market for intelligent telephones supplied by non-PBX manufacturers could possibly be in the order of $25-50 million per year.

- Voice Processing. Voice answerback, voice store and forward, voice recognition, etc., all have a number of places in the future of business communication, etiher in the form of new communication services or as accessories to existing services.

- Some of the required technology is available. Most of it remains to be developed. But the enhancement of voice communications by voice processing techniques is undoubtedly a huge business opportunity for the last half of the 1990s.

  - The market for voice processing, though perhaps unlimited, is, at this point, certainly undefinable.

D. RECOMMENDATIONS

1. MARKETING ISSUES

- Identify and sell to the leading-edge users. A very limited number of companies (less that 10% of the Fortune 500/50, and not necessarily the largest ones) have a solidly qualified communications organization capable of understanding their company's requirements, and at the same time have their management's confidence to act on these requirements.

  - These few companies are generally known to the communications industry, both their peers and their suppliers.

  - These leading-edge users are qualified both to recognize and to experiment with useful new products, and to speak with authority about their results.

  - With the "approval" of some of these leading-edge users, a new communication product can be successfully marketed in relatively short order.

  - Without such "approval," market development will be difficult or impossible.

- Products addressing new application areas should be sold to functional groups. If the user organization is being asked to buy a product for an application area that is either new or unclear to the user, the functional group closest to understanding that application is a better choice to sell to than the communications staff.

  - For example, in the case of facsimile, more units have been sold to sales managers than to communications managers.

- Products addressing defined user problem areas should be sold to communications staff. New network products for voice or data are typically sold to a person who understands not only the requirements but also the advantages and disadvantages of alternative solutions.

- The influence of industry groups in the purchasing process is often substantial and must be recognized. The influence of industry groups ranges from actually providing communications services (ARINC, railroads) to providing research and consulting guidance (retail, manufacturing). Whether the users buy through these industry groups or simply follow their advice, they have significant influence, which is growing rapidly in the communications area.

- Feature-selling works. Particularly in the non-leading-edge companies, product features can be (and frequently are) very instrumental in the purchasing evaluation. New high-technology features, some of which may not even be effectively usable, have been used by vendors very successfully to sell products to this market. The PBX selling process has many such examples.

  - Unless these features are in fact useless, this type of feature-selling is not unethical since it permits users to consider features that will someday be useful.

  - A good example of this is the remote peripheral capability of some PBXs. This feature cannot be used today because of the extremely limited availability of short-haul T carrier lines from the telephone companies. But when these lines become available, this will be a very powerful and useful feature.

- In-depth customer support must be provided. Bearing in mind that communication departments are generally understaffed, particularly voice communication departments, the introduction of new products and/or systems into a company will require much support for these staffs. This support will include:

- Consulting with the users' system staff on the proper use and installation of the product.

- Training of the users' operators, not only central site but possibly station operators as well.

- Possibly even operation of the product or system on a turnkey basis.

- Certainly provision of maintenance, or arrangement for such maintenance.

2. STRATEGY ISSUES

- Suppliers must protect their reputation carefully. The communication industry, particularly that segment made up of the major users and their suppliers, is a relatively small community in which a reputation, particularly for bad performance, can be established very quickly and disseminated even more quickly. Such was the case in this study for the specialized carriers' performance in remote areas. The reputation lost from these incidents, probably attributable to overextension of resources, will be difficult to regain and apears to have been avoidable.

- Vendors must plan for fast obsolescence. One of the major problems faced by many vendors, including IBM, is a product-obsolescence rate that took them by surprise. Users are being very careful about large and long-term financial commitments, particularly in 1980, but more for concerns about technological obsolescencce. There is no sign that this rate of obsolescence will decline. Planning must be very conservative in this respect.

  - In spite of forecasts seen elsewhere of "stopping-places in the market" where users hold for a new round of technology (e.g., in computerized PBXs), this study sees no such breaks in the continuing introduction and acceptance of new products.

- Services often migrate to products. The tradeoffs between services and hardware in the information industry are such that long-term forces tend to push all services in the direction of hardware. While this presents potential problems for the services provider, it also presents new strategic business alternatives for market development.

  - For example, functional products can be offered to the marketplace initially as a service with the long-term expectation that, if the function provided is useful, the natural forces will push the service users toward the purchase of the product. For example, the Comet electronic mail software is being offered this way.

  - Conceivably, new kinds of user functions, such as network management, might be effectively market-developed by offering them on a service basis first, with the intention of converting to user site hardware later.

- The influence of standards is growing. Communication standards, historically a documentation of de facto standards set by companies like AT&T and IBM, are moving very slowly into an initiating role. As such, vendors and potential vendors should be aware of existing standards and also of trends in the setting of new standards.

  - A particularly interesting new technique in standard-setting is the Xerox strategy being applied to Ethernet. This strategy, discussed in more detail in Appendix C, is very much in the initiative mode and should be watched by vendors not only because of what it means in its target area (local data networks) but also because of what its success could mean to future use of the standards process for gaining competitive advantages.

- Communications products must become more human-oriented. Historically communications have been, to the user, a very simple-to-use service. Any complex or specialized functions, such as network diagnosis or switchboard operation, were handled by abundant and relatively low-cost, specially trained

personnel. For a variety of reasons (equipment complexity, salary costs, etc.), those special personnel have been replaced by equipment. The user now interfaces with this equipment with little human point of recourse.

- In some cases, this is just as good; often it is better; but in some cases, it is unworkable.

- Call queuing is a good example. The switchboard operator could say, "I am now ready to place your call to Mr. Jones." The automatic call queuing systems in place now will simply ring the two phones and have two people saying, "Hello, who is this?"

- Human-oriented products and services are increasingly needed for end users and system operators.

• The communication staff in user companies is also marketing its services within the company. This is an important point to understand in both planning and marketing products to communications staffs. Ultimately, the objectives of the vendor of communication products and the purchaser of communications products are, if not identical, oriented in very much the same direction.

III ANALYSIS OF USERS' COMMUNICATION NETWORK REQUIREMENTS

III ANALYSIS OF USERS' COMMUNICATION NETWORK REQUIREMENTS

- The primary driving forces inducing a communication network or networks within large companies, are the requirements imposed by the user. These requirements are primarily the result of the type and size of the organization as well as the information-handling applications that organization performs.

A. USER ORGANIZATION

- A dominant factor in detemining the type and scope of telecommunication networks within any user organization is the description of the organization itself.

    - There are many different types of organizations: centralized, decentralized, integrated, multiproduct, etc.

    - Factors such as company size, industry classification and geographic scope of operations, as well as the manner in which a company transacts business with its customers and suppliers, and the strength of the relevant industry associations, are primary determinants of the type of communication networks chosen by a company.

I. TYPES OF ORGANIZATIONS

- Within the companies studied for this project, three major types of company organizations can be distinguished:

  - Strongly centralized.

  - Independent subsidiary.

  - P&L divisions/departments.

- The centralized companies tend to have similarly centralized communication networks. To the extent that they have multiple networks, there is a strong trend toward integration of these networks in the near future.

- The companies with independent-subsidiary organization tend to operate with completely separate networks for each of the independent subsidiaries. In some cases, communications personnel within the subsidiaries are attempting to integrate their various networks with those of other subsidiaries, but with little corporate-level support. In a few cases, there is a rudimentary corporate telephone network to serve some of the needs of intracorporation communication, but few of the communication requirements of the individual subsidiaries.

- In the case of the P&L divisions, there is usually a split between the type of voice network and the type of data network. Voice networks tend to be operated by corporate communications staff as a single corporate entity, whereas independent data networks exist in each of the independent divisions.

  - In addition, there is often a general corporate data and/or message network to serve some level of need: usually the needs of some of the smaller divisions that could not support an independent network.

- In most of these companies, there is work under way to develop an integrated corporate data network.

- A fourth type of corporate organization includes those companies that have developed a large corporate data processing capability and associated data network, put into a separate P&L operation so that it sells its services to outside companies as well as provides services to the corporation. Among these companies are the large aircraft companies.

- Most of the companies studied were centralized, as shown in Exhibit III-1.

- About 20% of the companies interviewed were in the process of experiencing a major change in corporate organization.

  - About half of these changes were simple, such as a move of corporate headquarters to another location.

  - In the other cases, the change was in the nature of acquiring (or being acquired by) another company, or some other major reorganization. This latter type of change usually caused extensive changes in the communication networks, particularly among the centralized types of organizations.

2. SIZE OF ORGANIZATION

- Since the sample of companies interviewed was drawn from the Fortune lists of the 500 largest manufacturers, and six of the 50 largest other industry groups, the smallest of the companies were still relatively large. The range of companies interviewed was from $400 million to $40 billion dollars in annual sales among the manufacturers, with an approximately comparable distribution from top to bottom of each of the groups of 50.

- Within employee size - a much more important statistic for communication network purposes - the range was from 1,000 to 400,000 employees.

EXHIBIT III-1

RELATIONSHIP BETWEEN TYPES OF CORPORATE ORGANIZATION AND TYPES OF COMMUNICATION NETWORKS AMONG FORTUNE 500/50 COMPANIES

TYPE OF ORGANIZATION	TYPE OF NETWORK (TYPICAL)	NUMBER STUDIED
CENTRALIZED	SINGLE VOICE NETWORK MAXIMUM OF THREE DATA NETWORKS	92
INDEPENDENT SUBSIDIARY	INDEPENDENT VOICE NETWORKS INDEPENDENT DATA NETWORKS	17
P & L DIVISIONS	SINGLE VOICE NETWORK SINGLE MESSAGE NETWORK MULTIPLE DATA NETWORK	37
DATA PROCESSING SERVICES RELATED	SINGLE VOICE NETWORK SINGLE DATA NETWORK	3

- Of at least equal importance, when examining communication networks, is the varying number of locations per company. The sample included companies with as few as eight locations, up to companies with almost 4,000.

- As shown in Exhibit III-2, the number of locations per company varies widely from industry to industry. Insurance companies within the Fortune 50 average only about 100 locations per company, whereas retail companies average almost 1,000 per company.

- In terms of the size of the operating units of the companies studied, there are about 30% of the total locations in the 100 to 1,000 employee range, and about 3% in the over 1,000 employee range.

- While the size distribution of locations in some industries (such as manufacturing and utilities) tends to be relatively uniform within the entire industry, other industries are really a composite of some widely divergent operations, so that averages are not quite as meaningful.

- These variegated industry groups include:

  - Banking, where the branching laws vary widely between, for instance, California and Illinois.

  - Diversified financial, where the companies include huge numbers of small consumer credit locations to very large manufacturing plants, often within the same firm.

  - Transportation, which includes railroads, trucking companies and airlines.

  - Retail, which includes the food chains with many locations, as well as the large department store chains with fewer, but larger, operations.

EXHIBIT III-2

AVERAGE NUMBER OF LOCATIONS PER COMPANY AMONG FORTUNE 500/50 COMPANIES

INDUSTRY SECTOR	TOTAL LOCATIONS	LOCATIONS WITH 100 TO 1,000 EMPLOYEES	LOCATIONS WITH MORE THAN 1,000 EMPLOYEES
ALL COMPANIES	264	81	9
DISCRETE MANUFACTURING	235	83	9
PROCESS MANUFACTURING	154	27	4
BANKING	107	3	1
DIVERSIFIED FINANCIAL	631	53	3
INSURANCE	101	46	3
TRANSPORTATION	214	51	11
UTILITIES	164	54	13
RETAIL	903	405	33

3. INDUSTRY SIGNIFICANCE

- Differences between industries were particularly dramatic. Most of these are attributable to differences in size and geographic location between companies in different industries; however, industry-related applications had significant impact on the types of networks implemented. Obvious examples are airlines, with their extensive reservation networks, and retail chains, with small voice networks and large POS networks.

B. INTERCOMPANY RELATIONS

- While all companies clearly have communication relationships of one kind or another with their suppliers and customers, the organized (e.g., data or message) telecommunications between such companies tend to fall into relatively narrow application areas.

  - Most of these organized intercompany relationships all into the category of communications within dealers. Dealers in this case represent a fairly broad group. For example, in the airline industry, they are travel agents. In the banking industry, they are correspondent banks. In the insurance industry, they are agents. In some manufacturing industries, they are organizations such as automobile and farm equipment dealers and wholesalers. In other manufacturing categories (such as food, appliances, etc.), the dealer is a wholesaler or distributor.

  - Many industries are experiencing a growing competitive requirement for extensive interaction with consumers. These include:

    . Airlines.

    . Banks.

- Utilities.

- Most of these consumer interactions are through voice communication, but there is a growing requirement for automated voice interaction, such as Bank-By-Phone. This subject is discussed later in this report.

- Clearly, the data processing services companies have an extensive array of organized data communications with their customers.

C. INDUSTRY GROUPS

- All of the companies discussed are involved in one way or another with industry groups. Some of these industry groups are exceedingly powerful in terms of their relationships to communications.

  - Specifically, ARINC in the airline industry is a large "middle-man" in terms of both voice and data networks. ARINC not only buys voice lines for the use of airline companies, but also provides an extensive amount of data and radio communication services to its member airlines.

  - While no other industry group represents as strong an influence as ARINC in its industry, many of the others provide consulting or research-type activities for their members.

  - The American Banking Association performs an extensive amount of research of all types (particularly studies of communication applications and expenditures) for its members. ABA has recently issued an RFI (Request For Information) relating to a possible industrywide communications network for the banking industry.

- The National Retail Merchants Association provides similar research services for its members.

- A summary of some of the related industry associations is shown in Exhibit III-3.

I. ABA BANK NETWORK FEASIBILITY STUDY

- In February 1978, at an ABA Bank Telecommunications Workshop in Houston, Texas, ABA presented a report on its preliminary investigation of a nationwide shared telephone system for bank-to-bank calling, which prompted the association to commission a feasibility study by AT&T.

  - The presentation of the preliminary report indicated that nationwide expenditures for telecommunications equipment and services within the banking industry had grown at 16% per year from the 1975 level of $550 million to $800 million for 1978.

  - Another series of ABA surveys also revealed that 80% of the 1978 amount was for "POTS" (Plain Old Telephone Service), and that some 20-40%, or $128-256 million, was attributable to long-distance calling.

  - With banks estimating that about 40% of long-distance calling was attributable to bank-to-bank calling, ABA surmised that $51-102 million would be spent by banks calling one another.

- The AT&T Bank Network Feasibility Study, commissioned by the ABA and later critiqued by the Network Analysis Corporation as "...an excellent study which is probably the most comprehensive analysis ever developed of telecommunications for a U.S. industry," identified three possible network configurations.

  - The network evaluation process involved three choices, but found the cost projections most favorable for the network that allowed full off-

EXHIBIT III-3

INDUSTRY ASSOCIATIONS INVOLVED IN MEMBERS' TELECOMMUNICATIONS ACTIVITIES

INDUSTRY	ASSOCIATION
AIRLINES	ARINC (AERONAUTICAL RADIO, INC.)
TRAVEL AGENTS	ASTA (AMERICAN SOCIETY OF TRAVEL AGENTS)
BANKING	ABA (AMERICAN BANKING ASSOCIATION)
RETAIL	NRMA (NATIONAL RETAIL MERCHANTS ASSOCIATION)
INSURANCE	IIR (INSURANCE INSTITUTE FOR RESEARCH)

net communications access. This offered a maximum annual savings of about $22 million if between 1,200 and 2,300 economically viable banks participated.

- The recommended network configuration allows for participating banks to call each other over the network, to call nonparticipating banks by "off-net" arrangements, and to call any nonbank location in the continental U.S.

D. TRAFFIC VOLUMES

- Telephone instruments exhibit a very uniform distribution of traffic volume from one instrument to another. Business telephones typically operate 45 minutes per day.

- Data communication devices range from 10,000 characters per day for operator terminals, to a few hundred million characters per day in a large computer center. The devices connected to user networks in this study included:

  - Individual operator terminals, both local and remote, each of which originated interactive traffic of between 10,000 and 50,000 characters per day.

  - Clustered operator terminals, which generate a multiple of the individual terminal volumes.

  - Clustered transaction terminals, which originate batch traffic volumes of between 50,000 and 500,000 characters per day.

- Media or batch data terminals, many of which are minicomputers or even mid-range computers, which generate batch traffic volumes of between 100,000 and one million characters per day.

- Message, facsimile and electronic mail devices also exhibit relatively uniform distributions of traffic volume between devices in a network, usually in the range of five messages per day.

E. NETWORK MANAGEMENT

- As user networks become more complex, larger, more expensive and, most of all, more critical to the operations of the company, a great need arises for managing and controlling these networks. In addition to the growing magnitude of the problem, the situation is exacerbated by the decline in availability of technical personnel qualified to manage communication networks.

- This section of the report examines the requirement for the performance of management functions in both voice and data networks, and the present methods by which users are performing this function. A summary of the types of operations performed by network management is shown in Exhibit III-4.

- INPUT has organized users' comments on network management so that they represent a composite of the perceived needs of major network users for performing the various functions required in managing a network.

1. NETWORK MONITORING

- Various components of the network may degrade or fail at random. The objective of the network monitoring function is to detect that degradation or failure before it affects network operations.

EXHIBIT III-4

NETWORK MANAGEMENT OPERATIONS

COMPONENT SUBSTITUTION

- MODEMS, CIRCUITS, MUX CHANNELS
- LOCAL OR REMOTE
- COMPONENT SIMULATION

COMPONENT TESTS

- ANALOG; PHASE JITTER, S/N RATIO, ENVELOPE DELAY
- DIGITAL; BIT/BYTE/BLOCK ERROR RATE, ERROR TRAP, EIA INTERFACE

TEST CONTROL

- LOOPBACK
- DATA COLLECTION
- DATA ANALYSIS

NETWORK MONITORING

- COMPONENT MONITORING; LINE FAILURE
- SYSTEM MONITORING; TERMINAL QUEUE LENGTH, RESPONSE TIME

NETWORK MANAGEMENT

- RECONFIGURATION
- COST CONTROL
- USER SATISFACTION

- The detection may be a GO/NO-GO test; e.g., the component is working or it is not working.

- The detections may be a more sophisticated measurement to determine whether some performance parameter of the network component has dropped below a predetermined threshold and is probably going to cause a failure in the near future.

- Many performance factors in communication elements, particularly in transmission channels, tend to degrade before they become completely unusable.

- Network monitoring is a process that, to be effective, must be peformed continually or at very short intervals. This implies not only an automated monitoring system but also a test procedure that can be conducted with minimal interference to the ongoing data communications operations. Such systems are becoming available and will be discussed in Chapter VI.

- While network monitoring may seem to be an obvious requirement, it is for most users a relatively recent consideration. Generally, network performance has been controlled in the past by initiating action only in the case of failures.

  - In some cases, particularly in voice networks, failures may in fact go unnoticed for extended periods of time. For example, in a trunk group, a failed or seriously degraded circuit may continue undetected for days because, either by manual or automatic means, other trunks in the group serve the traffic requirement.

  - With a network monitoring approach, all trunks would be tested periodically, and the defective trunk would be corrected or replaced. If not, credit for out-of-service condition could be obtained from the carrier.

2. DIAGNOSTICS

- When a failure or degradation is detected by network monitoring, it usually requires some further diagnosis to pinpoint the cause of the problem and enable it to be corrected. This diagnostic process includes some optimum combination of test equipment, testing procedures and the use of data available from other network sources.

  - Analog test equipment, designed to measure the characteristics of voice and analog data communication channels, has been available for many years. It is usually operated by carrier personnel and only rarely by user personnel. As users get more involved in the control of their own networks, some ability to use this kind of test equipment will be necessary in order to manage the maintenance performance of the vendors or, in some cases, to actually perform corrective actions on the increasing array of customer-owned communication equipment.

  - Digital test equipment, such as line content monitors, has become available in recent years. In both of these cases, the use of the test equipment requires a relatively sophisticated communication technician, which, as earlier noted, is in relatively short supply. Thus there is an increasing requirement for the automation of these kinds of tests.

3. REMOTE TEST CONTROL

- Not only automation but also remote test control are necessary capabilities in order to perform diagnostic testing on a communication network without sending technicians to the remote site. This means that equipment must be connected at the remote site with sufficient intelligence to be able to perform certain tests on its own and to be put into various test and test-reporting modes. Such equipment is becoming increasingly available.

4. NETWORK CONTROL

- After a failure or potential failure has been detected and diagnosed by the monitoring and test systems, some action must be taken to correct the situation. This is the network control process.

- Operational control of the network takes two general forms. One is the immediate corrective action that can be undertaken by the operator or by the system itself, and the other is the control of the actual maintenance and restoral activities of user and/or vendor personnel.

- In many cases, there are immediate actions or adjustments that the operator of the communication network can take to eliminate, or at least reduce, the effect of a failure within the network. These actions include such things as switching in spare modems or spare lines, rerouting lines through other paths, imposing reduced flow controls, etc. Many of these control actions can be performed automatically by some of the more sophisticated systems.

- Regardless of the immediate corrections or adjustments that can be made by the operator or the system, a failure or degradation usually means that something needs to be fixed or replaced within the network.

- A complete network management system will include a maintenance control system that contains the following elements:

  - A definitive diagnostic system to assure that the problem is in fact real, well defined and located, in order to eliminate false call-outs.

  - A system for buffering the immediate impact of the problem by modem switching, rerouting, etc., so that maintenance is not performed in a panic, but can be scheduled to at least some degree.

  - A reporting and record-keeping system that controls the status of various outages.

- A report on the subject of maintenance control was prepared by INPUT in December, 1979.

5. NETWORK PERFORMANCE MEASUREMENTS

- In addition to monitoring the various elements of the network for their performance, the overall performance of the network needs to be measured, recorded and later analyzed. The network measurements made here include such things as response times, transaction delays, terminal or buffer queue lengths, etc.

- Another key performance measurement is the level of user satisfaction. This can sometimes be measured indirectly by factors such as call-holding times. For example, a very short call-holding time may be an indication that users were unhappy with the quality of the line and disconnected in order to replace the call on a different line.

- In both voice and data networks, traffic volume is one of the best measurements of network performance. Traffic measurement in both data and voice networks has generally tended to be a relatively crude operation.

  - Finer measures of traffic now becoming available in voice and data communication products will provide information for both immediate corrective action on the network and long-term adjustments to the configuration and equipment of the network.

- An examination of the various failure incidents and other occurences within the network can point to a need for making some changes (perhaps in equipment or vendors), and it may also indicate the possibility of obtaining rebates from vendors for capabilities not actually provided, such as circuits unused due to poor circuit performance.

- An analysis of incidents can, like network monitoring, often point to an impending failure so that corrective action can be taken before a failure actually occurs.

6. NETWORK PERFORMANCE STANDARDS

- Particularly for purposes of guiding the network operator, a set of standards needs to be established for the networks. These standards should indicate conditions that would generate different types of corrective actions and specify the normal corrective action.

  - These standards include, for example, some things that are deceptively clear, such as the definition of a failure.

  - Some of these operating standards are in fact implemented in network control software, whereby corrective action is automatically taken at specified levels or at specified incidents within the network.

7. NETWORK PERFORMANCE ANALYSES

- On a long-term (that is, month-to-month) basis, most companies find that these performance analyses reveal a need to make changes in the network configuration.

  - This includes adding lines, adding higher-speed lines, changing routings from one node to another, establishing high-traffic trunks to bypass intermediate nodes, etc.

- Longer-term adjustment to the network in order to obtain maximum utilization of this expensive corporate capability, recognizes that the use of the network is a continually changing process.

- The changes originate from both external influences, such as the ultimate users of the network and their requirements, and changes within the network.

- A continuing examination of the volume and type of traffic transitting the network can often indicate areas for optimization, either by changes in the network or by changes in the controls applied to the users.

    - A point made eleswhere in this report is the decline in actual use of the network, which often occurs as a result of billing back usage to the originating departments.

    - The simple existence of information available to end users as well as the responsibility of paying for their own use, often creates a reevaluation of the need for many different types of uses.

F. LOCAL NETWORKS

- Historically, most of the attention in the communication industry has been paid to long-distance communication requirements. Long distance is where large sums of money were spent and where the trade-off alternatives were available. Local communications, either within a building or within a city, were left in the hands of the telephone company.

- Recently, however, the situation has begun to change. Communication managers and data communication planners are becoming more involved with those local networks. A number of factors have combined to create this change in emphasis.

    - First, local communications, at least outside of the building, are no longer "free." The unlimited local call is no longer available to businesses in most cities.

- Second, new technology has been brought into the picture, both in terms of devices such as computerized switches and in terms of transmission facilities such as coaxial cable systems and digital multiplexing.

- Third, new participants have arrived to provide such local services. The Carterphone decision in 1968 brought many new companies into what is called the interconnect business, providing private local telephone systems for companies.

- Fourth, there is a growing realization, fueled by the increasing availability of alternatives, that the vast majority of corporate communications does indeed stay within the building. Studies have shown that at least 60% (and in some industries, such as banking, perhaps up to 90%) of the communications traffic remains within a single building.

I. TWO CLASSES OF LOCAL NETWORKS

- It is important to distinguish between the two classes of local networks:

  - Intrabuilding (or intracampus) networks.

  - Intracity networks.

- These two classes of networks are very different types of communication networks, primarily because the constraints that exist in intracity networks do not exist in intrabuilding networks.

- Intracity networks require communication facilities that cross property that is either public or owned by others. The franchise to own and operate such facilities is the fundamental domain of the common carrier.

  - Facilities other than voice telephone circuits are almost nonexistent today, and, while improving, will be very limited for the foreseeable future.

- Users planning to implement such facilities on their own face tremendous obstacles.

- Some alternatives implemented by users interviewed for this study are discussed in a later section.

• On the other hand, intrabuilding networks are entirely on the users' premises, and users can basically implement anything they can afford. There is a growing number of alternatives available to the user.

• Until recently, users have used the local telephone company exclusively to provide the inside wiring for telephone and low-speed data terminal connections within the building. They have used special wiring from the computer manufacturers to interconnect high-speed data equipment, such as cluster controllers and high-speed batch terminals.

2. LOCAL NETWORK APPLICATIONS

• The requirements for local networks fall into five categories of applications, by equipment class:

  - Voice telephones.

  - Low-speed data terminals.

  - High-speed or clustered data terminals.

  - Electronic mail systems.

  - Special laboratory or factory data systems.

• Facsimile and message applications are rarely implemented on a local network basis, except for the access to a long-distance facility.

- Most message terminals are found in dedicated locations (the "comm room"), with dedicated circuits routed from the carrier premises directly to that room.

- High-speed facsimile is also usually located in a "comm room."

- Low-speed or convenience fax usually rides on the voice telephone network.

- The number of voice telephones installed at a given location is very much related to the number of employees at that location.

  - With a few exceptions, the number of telephone instruments in a location is almost identical to the number of employees.

  - The exceptions are:

    . Production facilities and warehouses, where the ratio is one phone for every three employees.

    . Retail locations, where the ratio is now one phone for every two employees, but declining as central checkout operations expand.

- The number of low-speed data terminals installed in large locations varies widely, depending on a number of factors:

  - Locations with a high percentage of staff-type personnel (such as engineering centers) may have terminal ratios as high as one terminal for every three employees.

  - Retail locations and production facilities have ratios of about one terminal to fifty or more employees.

- IBM-oriented shops (including most of the large companies studied for this report) tend to use clustered CRT terminals for most applications.

- High-speed or clustered data terminals tend to be the dominant type of data terminals used in the large locations within large companies. The applications are both analytical and transactional, although both are not usually performed on the same device.

  - The density of high-speed and clustered data terminals tends to follow much the same pattern as that of telephones, except at a lower ratio of terminals to employees.

  - The estimated density of high-speed and clustered terminals in large locations is about one per ten employees, with the exception of production, distribution and retailing locations, where the ratio is one per hundred employees.

- Electronic mail systems are at a very formative stage in most large companies, and clear application requirements are difficult to establish. Among the companies with the most experience in this area, the primary electronic mail applications derive from two sources:

  - Remote extensions of "typing pool" systems.

  - Special interest groups within the corporation, such as engineering project teams and sales departments.

- In the "typing pool" situations, the primary requirement is to alleviate the mailroom delay problem with printer extensions or complete remote operator devices communicating with a shared word processor. In these cases electronic mail is mostly used to print the final copy of a memo at the closest location to the recipient.

- In the case of the special interest groups, the application is more of an electronic mail system, as defined earlier. The basic purpose of the network is to enhance the communication between associates, particularly replacing less convenient voice telephone operations.

  - Many of these electronic mail systems are "home-made" adaptations of timesharing computer systems, but an increasing number use specially designed software or, in some cases, vendor-supplied services.

  - A few of these electronic mail systems are quite large, in some cases ranging up to a few thousand subscribers.

- Special laboratory or factory data systems are local interconnections of multiple computers, laboratory instruments and industrial control systems. These systems are usually required to handle high data rates, and the nature of the applications varies widely.

- A very high percentage of intrabuilding traffic is performed interactively.

G. NETWORK GEOGRAPHY

- One of the most important requirements of a communications network is the geography or distance it must cover in connecting all of the necessary locations.

  - Generally speaking, the larger the company, the greater the physical size of the network in both number of stations and miles of circuits.

  - There are, however, significant differences between companies of the same size, attributable to type of industry, methods of distribution, size of major facilities, etc.

I. GEOGRAPHY OF USER OPERATIONS

- Banks, for example, operate almost exclusively within one state. In some states, such as Illinois, where there is no branch banking, the banks tend to operate in a very limited number of locations within that state. In most banks there are some out-of-state offices for conducting special types of business (e.g., international), but these tend to be a few, relatively small locations.

- In the utility industry, there is also a close correlation between communication networks and the users' narrowly defined geographic area. This in turn has a significant impact on the types of networks and the manner of implementing these networks. Private microwave, for example, is a very important component of the communication network in most utilities.

- Similarly, in the transportation industry, the geography of the network, while not as narrowly constrained as that for utilities, tends to be in a relatively defined area. This is particularly true of railroads and trucking companies. It is less true of airlines. The right-of-way companies, such as railroads, use an extensive amount of private microwave.

- Retailing companies within the Fortune 50 list tend to be relatively widespread geographically. While most of the retail companies studied have large sections of the country that they do not serve, they are all operating basically nationwide. However, most of the retail chains operate with substantially independent, geographically oriented divisions (or in some cases, subsidiaries), thus making the communications networks within those independent divisions or subsidiaries relatively separate networks.

- Manufacturers tend to have most of their plants in the mid-section of the country, ranging from the Great Lakes area down to the Gulf Coast. While many of the largest manufacturers have locations on the East and West

Coasts, they tend to have their major locations toward the center of the country, particularly in the the Great Lakes area. Heavy manufacturing companies, such as the metals and chemicals manufacturers, generally !ocate their plants in semiremote locations away from big cities.

2. GEOGRAPHIC SPREAD

- The geography of the communications network marketplace is a difficult item to express as an overall average.

  - As seen in Exhibit III-5, when a sample (82 companies) is averaged in terms of location (by area of the country), the distribution is very close to that of the overall U.S. population.

  - When data are aggregated by manufacturing, financial industries and distribution industries (finer industry groupings allow too much sampling error), it can be seen that the Fortune companies tend to locate their headquarters in the Middle Atlantic and Great Lakes areas, whereas their plant locations are further south.

- Another method of examining the geography of these large company networks is to develop a figure for the land area that would be encompassed within the perimeter of the network.

  - This was done by making the assumption (admittedly crude) that if the company had two or more locations in a state, the land area of that state is "covered" by the company network. The total land area "covered" by the network divided by the total U.S. land area then gives a geographic distribution measure of each company's network.

  - The results are shown in Exhibit III-6.

- Manufacturing companies typically have much larger geographic networks than other industries do.

EXHIBIT III-5

GEOGRAPHIC DISTRIBUTION OF FORTUNE 500/50 LOCATIONS

GEO-GRAPHIC REGIONS	LOCATIONS (AS A PERCENT OF TOTAL)					
	US POP-ULATION	COMPANIES IN STUDY				FORTUNE 500/50 HEAD-QUARTERS
		TOTAL	MANU-FACTURING	FI-NANCIAL	DIS-TRIBUTION	
NEW ENGLAND	5.7%	4.8%	4.8%	4.5%	3.3%	9.5%
MIDDLE ATLANTIC	17.3	17.3	14.3	25.2	15.4	28.4
EAST NORTH CENTRAL	19.0	16.7	18.7	13.3	11.6	24.7
WEST NORTH CENTRAL	7.8	6.7	7.0	5.0	8.3	6.4
SOUTH ATLANTIC	15.8	16.0	17.7	10.4	13.0	8.5
EAST SOUTH CENTRAL	6.4	5.3	6.5	2.2	2.7	1.5
WEST SOUTH CENTRAL	10.0	12.6	14.6	10.0	11.3	6.8
MOUNTAIN	4.6	4.8	3.7	5.6	8.7	2.4
PACIFIC	12.8	15.2	13.0	23.1	23.7	11.8
TOTAL*	100%	100%	100%	100%	100%	100%

*ROUNDED

EXHIBIT III-6

GEOGRAPHIC AREA OF THE COUNTRY COVERED BY CORPORATE NETWORKS: INDUSTRY AVERAGES FOR FORTUNE 500/50 COMPANIES

	PERCENT OF COUNTRY WITH TWO OR MORE COMPANY LOCATIONS PER STATE
MANUFACTURING	40%
FINANCIAL	21
DISTRIBUTION	25
ALL COMPANIES	35%

- Although the sample data are not large enough to detail industries such as banking and utilities, the coverage of these industries is in the range of 15% or less range.

- Of interest also is the range of coverage, from the lowest to the highest, as shown in Exhibit III-7.

  - Most of the companies under 10% are utilities, but there are also a few very centralized manufacturing firms.

  - The companies in the high-coverage range, 75% or over, are the very large, multiproduct, discrete manufacturing companies.

3. MULTIPLE LOCATIONS IN THE SAME CITY

- Another situation of great importance to users in the implementation of networks is that of multiple, large operating facilities located close to each other.

  - In the automobile industry in Detroit, for example, the auto companies have numerous plants within short distances of each other.

  - The importance of this situation is that nearby locations tend to have large amounts of communication with each other.

- As shown in Exhibit III-8, about half of the companies in the sample have at least one situation where they operate two or more large (over 1,000 employees) facilities in the same city.

  - Many companies have this situation in a number of cities. The average for all companies was 1.6 such multiple locations per company for the 48% of companies that had multiple locations in the same city.

EXHIBIT III-7

GEOGRAPHIC AREA OF THE COUNTRY COVERED
BY FORTUNE 500/50 CORPORATE NETWORKS

PERCENT OF COUNTRY COVERED	PERCENT OF COMPANIES
LESS THAN 10%	12%
10-25%	25
25-50%	40
50-75%	18
75-90%	5
MORE THAN 90%	0

EXHIBIT III-8

NUMBER OF FORTUNE 500/50s
IN SAMPLE WITH MULTIPLE, LARGE*
LOCATIONS IN THE SAME CITY

INDUSTRY SECTOR	PERCENT OF COMPANIES WITH TWO OR MORE LARGE SITES IN SAME CITY	AVERAGE NUMBER OF MULTIPLE SITE SITUATIONS PER COMPANY
MANUFACTURING	62%	1.2
FINANCIAL	27	2.0
DISTRIBUTION	41	2.5
OVERALL	48%	1.6

*LARGE SITE HAS 1,000 OR MORE EMPLOYEES

- This means that one-fourth of the large locations are found in the same city as at least one other large location of the same company. Within this marketplace there are about 2,000 large facilities.

- Many companies are looking for economical, wideband, local-loop capabilities in order to interconnect these facilities, as well as smaller ones.

IV STATUS OF USERS' EXISTING COMMUNICATION NETWORKS

IV STATUS OF USERS' EXISTING COMMUNICATION NETWORKS

A. DEFINITION OF A NETWORK

- Before discussing the networks used by large companies, it is necessary to define the different types of networks referred to in this study.

  - Voice Network: Multiple (10 or more) voice switching nodes (PBXs) interconnected by dedicated lines. (Definition based on method of connection.)

  - Data Network: Multiple data communication devices (terminals, computers, etc.) interconnected by communication lines to a data processing system at another location. (Definition based on products at the end points.)

  - Message Network: Multiple message communication devices (printers, CRTs) interconnected by communication lines to each other, with or without an intermediate message switch. (Definition based on products at the end points.)

  - Facsimile (FAX) Network: Multiple facsimile devices interconnected by communication lines to each other. (Definition based on products at the end points.)

- <u>Electronic Mail Network</u>: Multiple message communication devices (printers, CRTs) interconnected to each other by communication lines and a message management system. (Definition based on method of connection.)

B. USE OF COMMUNICATIONS NETWORKS

- While all of the companies studied had communication requirements and communication facilities, many of these companies did not have organized corporate communications networks.

- Exhibit IV-1 shows the number of companies <u>without</u> various types of corporate communications networks. At first glance, some of these results are startling.

  - Over one-fourth of these very large companies do not have a corporate voice network.

    - This does not mean that these companies have no voice communication between locations, but rather that they use the public-switched telephone network for these communications.

  - On the other hand, only 4% of the companies do <u>not</u> have some kind of data network.

    - For all of the companies with a single data network, it is corporate-wide.

    - For the companies with multiple data networks, there is always some form of organized data transfer between them.

EXHIBIT IV-1

PERCENT OF FORTUNE 500/50 COMPANIES WITH VARIOUS TYPES OF CORPORATE COMMUNICATIONS NETWORKS

TYPE OF NETWORK	PERCENT OF COMPANIES NOT HAVING NETWORK
VOICE	26%
DATA	4
MESSAGE	14
FACSIMILE	24
ELECTRONIC MAIL	85

- The reason for this apparent discrepancy is that many companies accept the public-switched telephone network as a highly practical solution to their long-distance voice requirements, whereas public data networks do not yet exist with sufficient generality to be the corporate network.

    - Of the 26% of companies without a corporate network, most (22%) had multiple data networks with at least some level of data interchange between networks.

- In the case of the message networks, while most of the large companies have message networks, many of these are used primarily for external communications, particularly international. These message terminals are often used for their access or gateway capability rather than their network capability.

- Facsimile networks, on the other hand, are used almost exclusively at present for intracompany applications.

- Electronic mail networks are relatively new and still somewhat rare. Many of the companies using electronic mail networks are operating primarily on an intra-building basis.

C. NETWORK CONFIGURATIONS

- Large corporate networks, such as those used by the large companies examined in this study, tend to evolve into nodal networks (as opposed to ring, mesh, broadcast or other types or networks).

    - These nodes, or points of concentration in the network, can be either natural or contrived.

. Natural nodes are those that result from being located at a large end point, such as a computer center, or at a large concentration of employees, such as a large office building.

. Contrived nodes are those that are established by the network designer for purposes of achieving network economies. Tandem switches in a voice network fall into this category, as do remote concentrations in data networks.

- About 90% of the large companies have four or fewer major switching nodes in their voice networks, as shown in Exhibit IV-2.

  - The companies with five or more nodes tended to be either local power companies with large, private microwave networks or the large AT&T, CCSA or EPSCS users.

  - The companies with one to four switching nodes had them distributed geographically around their networks.

  - In most cases, these major switching nodes were colocated with a natural node (a large facility); but in a number of cases, at least one of these nodes was located at a smaller facility for reasons of network economics.

- Computer centers tended to be much less related to network geography, as they were usually colocated with, or close to, the headquarters or the organization served.

  - The number of major computer centers per company (defined as the central processing point for one or more data communication networks, or a 370/158 or larger batch processing center) varies widely, ranging from one to 54. These data are shown in Exhibit IV-3.

EXHIBIT IV-2

NUMBER OF MAJOR SWITCHING NODES IN
VOICE TELEPHONE NETWORKS AMONG
FORTUNE 500/50 COMPANIES

NUMBER OF NODES	NUMBER OF COMPANIES
1	25
2	17
3	17
4	12
5 OR MORE	9

(80 VALID RESPONSES)

EXHIBIT IV-3

NUMBER OF MAJOR DATA PROCESSING
CENTERS PER COMPANY AMONG
FORTUNE 500/50 COMPANIES

NUMBER OF CENTERS	NUMBER OF COMPANIES
1	40
2	20
3	16
4	11
5 TO 10	10
11 TO 25	7
26 OR MORE	2

(106 VALID RESPONSES)

- All of the companies with a large number of computer centers now operate them without any telecommunications interconnection between the centers. As will be shown later, most of these companies are planning major changes in their data communications networks, which will include a reduction in the number of major computer centers and usually some level of computer center interconnection.

- The few companies that have a large number of computer centers and were not planning to change, were the very decentralized management companies.

- Most of the companies with one computer center are the smaller of the Fortune 500/50, but there are a few of the very largest companies also in this category.

D. THE ELEMENTS OF A NETWORK

- A communications network, voice or data, is made up of a number of reasonably distinct elements. These elements are shown on Exhibit IV-4.

  - The network nodes that have been discussed are the network switches in the voice networks and the computer front end in the data networks.

  - Other networks for message, facsimile or electronic mail tend to implement various combinations of these same elements.

EXHIBIT IV-4

NETWORK ELEMENTS
FOR VOICE AND DATA NETWORKS

VOICE NETWORK	DATA NETWORK
-	COMPUTER/FRONT END
LONG-DISTANCE TRANSMISSION	LONG-DISTANCE TRANSMISSION
NETWORK SWITCHING	DATA SWITCHING (MUX, CONCENTRATOR, ETC.)
LOCAL TRANSMISSION	LOCAL TRANSMISSION
PBX	MODEMS
INSIDE WIRING	INSIDE WIRING
TELEPHONE INSTRUMENTS	TERMINALS

E. VOICE NETWORKS

I. NETWORK SWITCHING

- As previously noted, about one-fourth of these large companies do not operate a corporate voice network. This means that they have no private long-distance transmission elements and no private network-switching elements. They use the public-switched long-distance network provided by the telephone carriers.

  - Most of these companies are large users of WATS.

- Of the other 74% of the companies studied, 50%, as shown on Exhibit IV-5, use some form of dedicated tandem dial (the network-switching element) and 10% have this function provided by AT&T on a service basis with CCSA or its electronic replacement EPSCS.

- The remaining 14%, shown on Exhibit IV-5 as Miscellaneous Types, have a network with private long-distance transmission (PBX tie lines) but without the network-switching element.

- The type of network implemented is somewhat influenced by the size of the network in terms of number of locations, as shown in Exhibit IV-6.

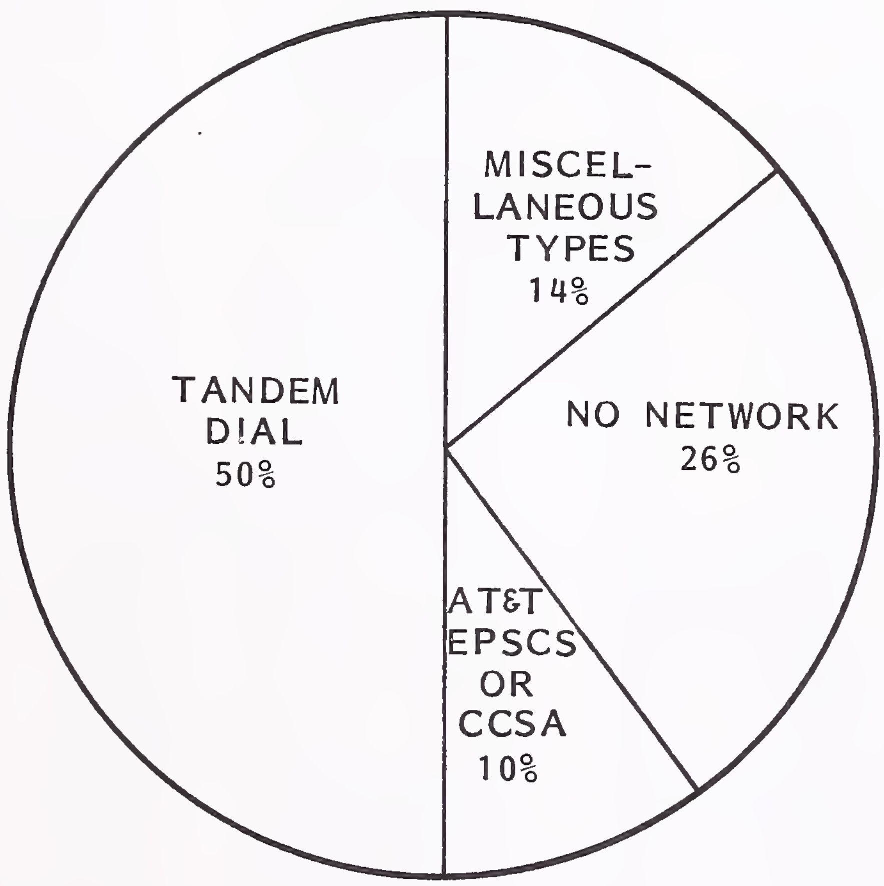
- The type of network implemented is more strongly influenced by the size of the company in terms of number of employees, as shown in Exhibit IV-7.

- In examining the effect of industry segment on the type of network, some interesting anomalies appear, as shown in Exhibit IV-8.

  - Almost all of the AT&T network-switching services are found in the discrete manufacturing sector.

EXHIBIT IV-5

TYPE OF VOICE NETWORK INSTALLED IN
FORTUNE 500/50 COMPANIES



NUMBER OF VALID RESPONSES = 119

EXHIBIT IV-6

TYPE OF VOICE NETWORK INSTALLED
BY NUMBER OF LOCATIONS PER COMPANY
AMONG FORTUNE 500/50 COMPANIES

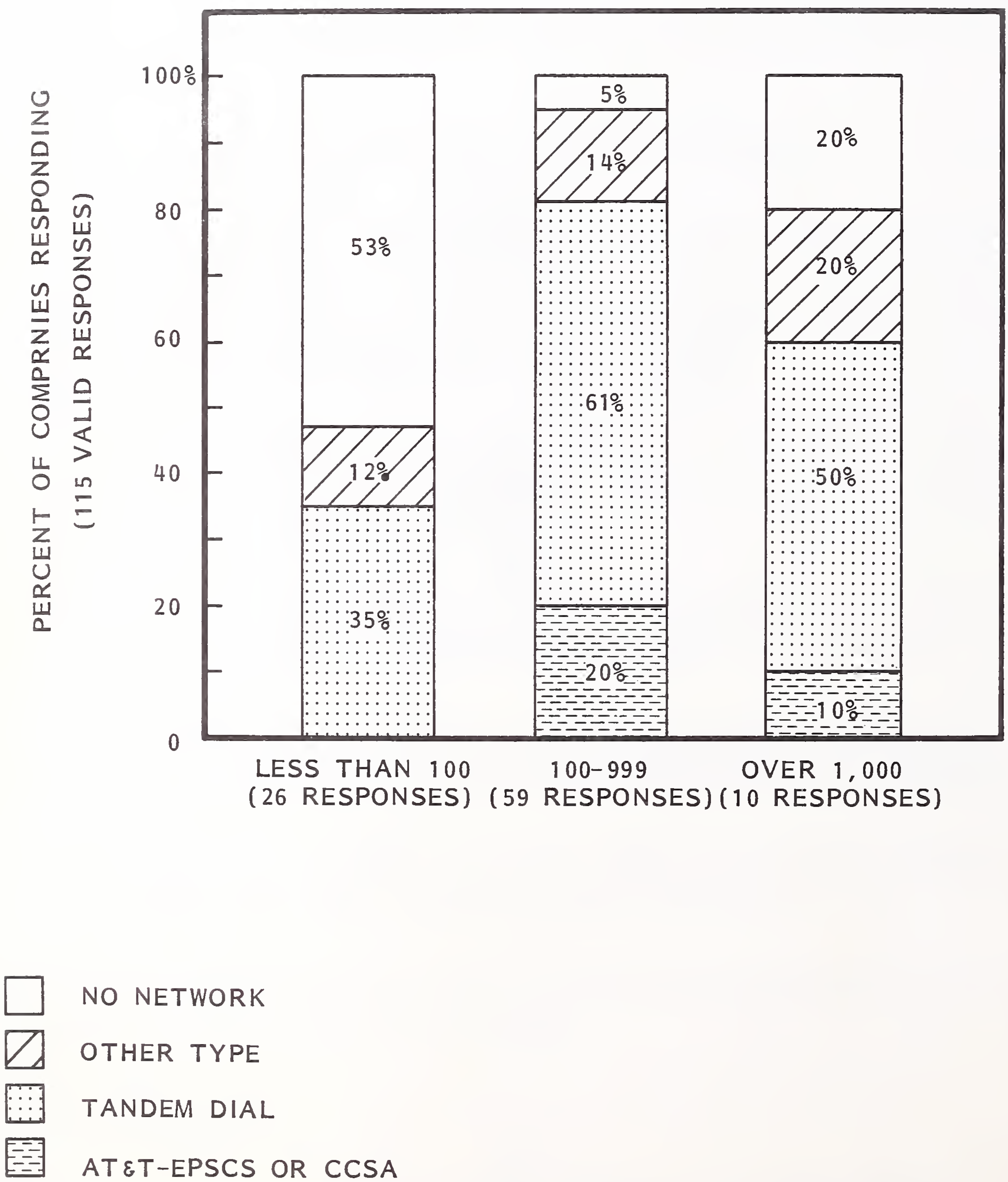


EXHIBIT IV-7

TYPE OF VOICE NETWORK INSTALLED
BY EMPLOYMENT SIZE OF
FORTUNE 500/50 COMPANIES

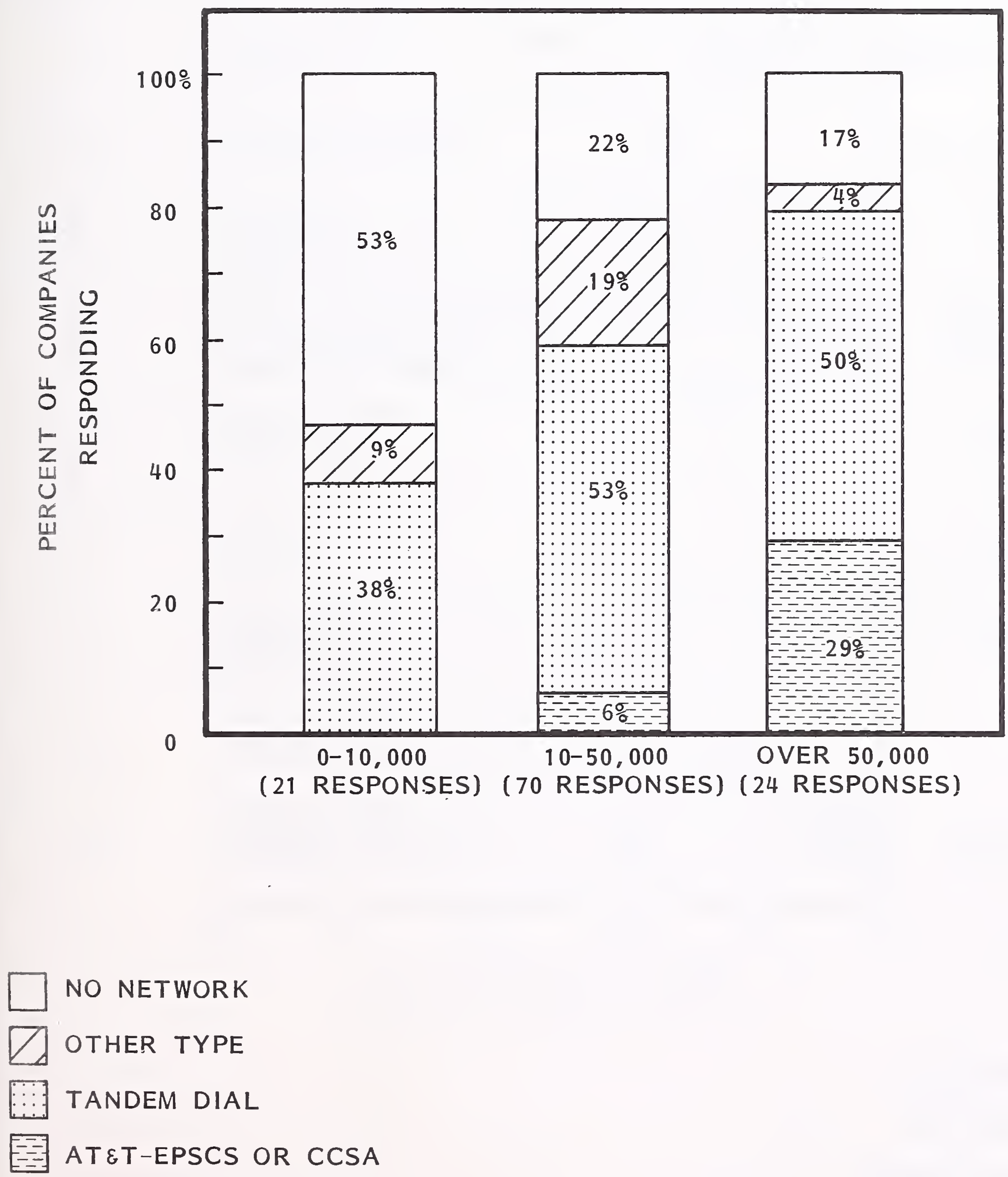
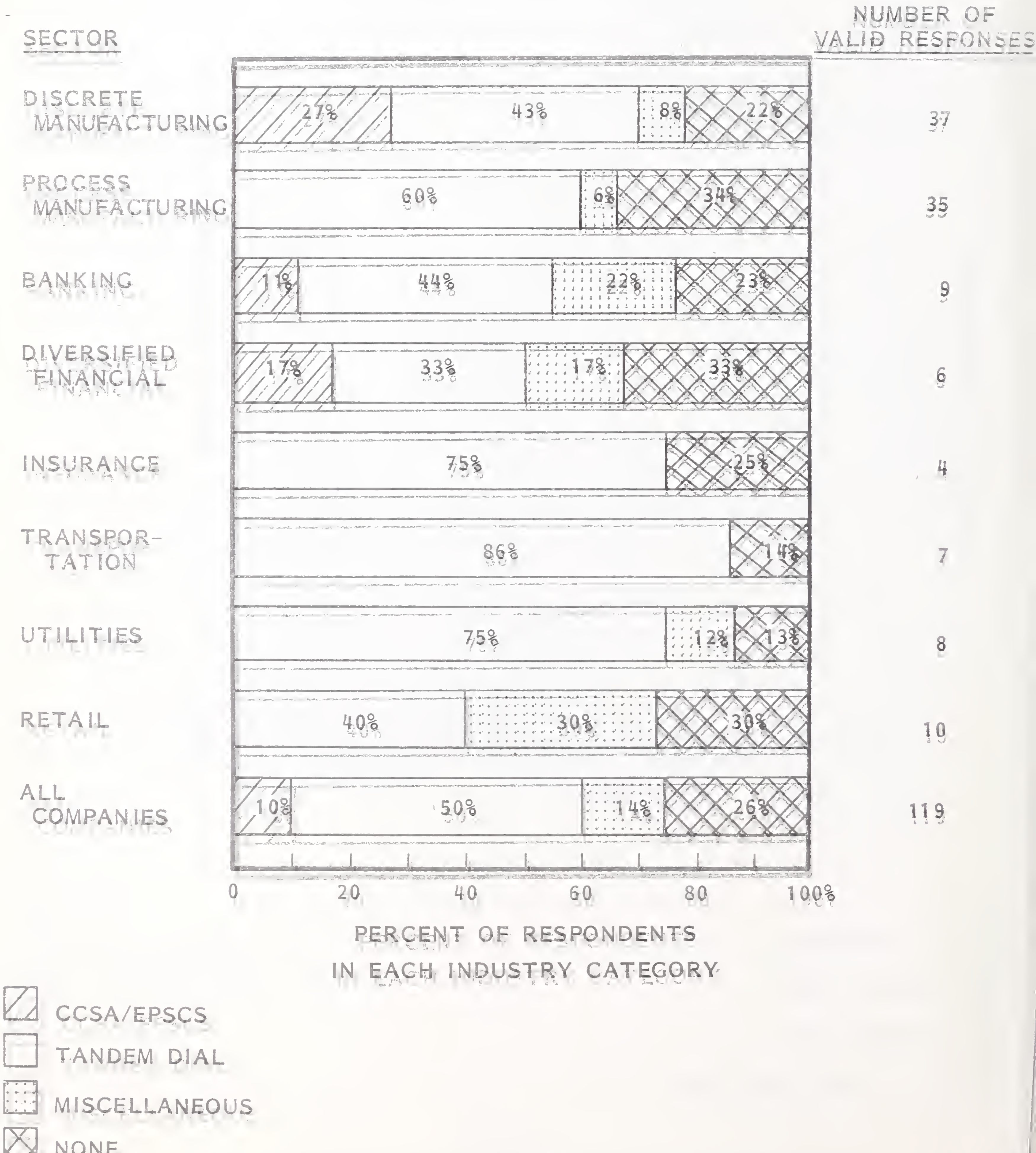


EXHIBIT IV-8

TYPE OF VOICE NETWORK INSTALLED,
BY INDUSTRY, AMONG
FORTUNE 500/50 COMPANIES



- While the Fortune 50 sectors have relatively small samples from which to draw valid conclusions, it should be noted that the transportation and utilities sectors show high penetration of tandem switch systems. This is a surprising finding in view of the extensive amount of lower-cost microwave systems in the utilities and railroad industries and the availability of ARINC Telpak in the airline industry.

- AT&T is the primary voice network supplier for the companies using CCSA/EPSCS and for the companies without networks (which use MTS/WATS). AT&T, along with the other carriers (telephone and OCCs), are also the primary providers of the PBX tie-line networks.

- Tandem-switching is one area where inroads are being made into AT&T's voice network market dominance. As shown in Exhibit IV-9, AT&T controls about two-thirds of the tandem-switching market. (AT&T controls a share of the mixed systems segment.) AT&T's share of that market is declining fairly rapidly considering that the other suppliers were, for all practical purposes, not in the private tandem switch market five years ago.

2. PBX

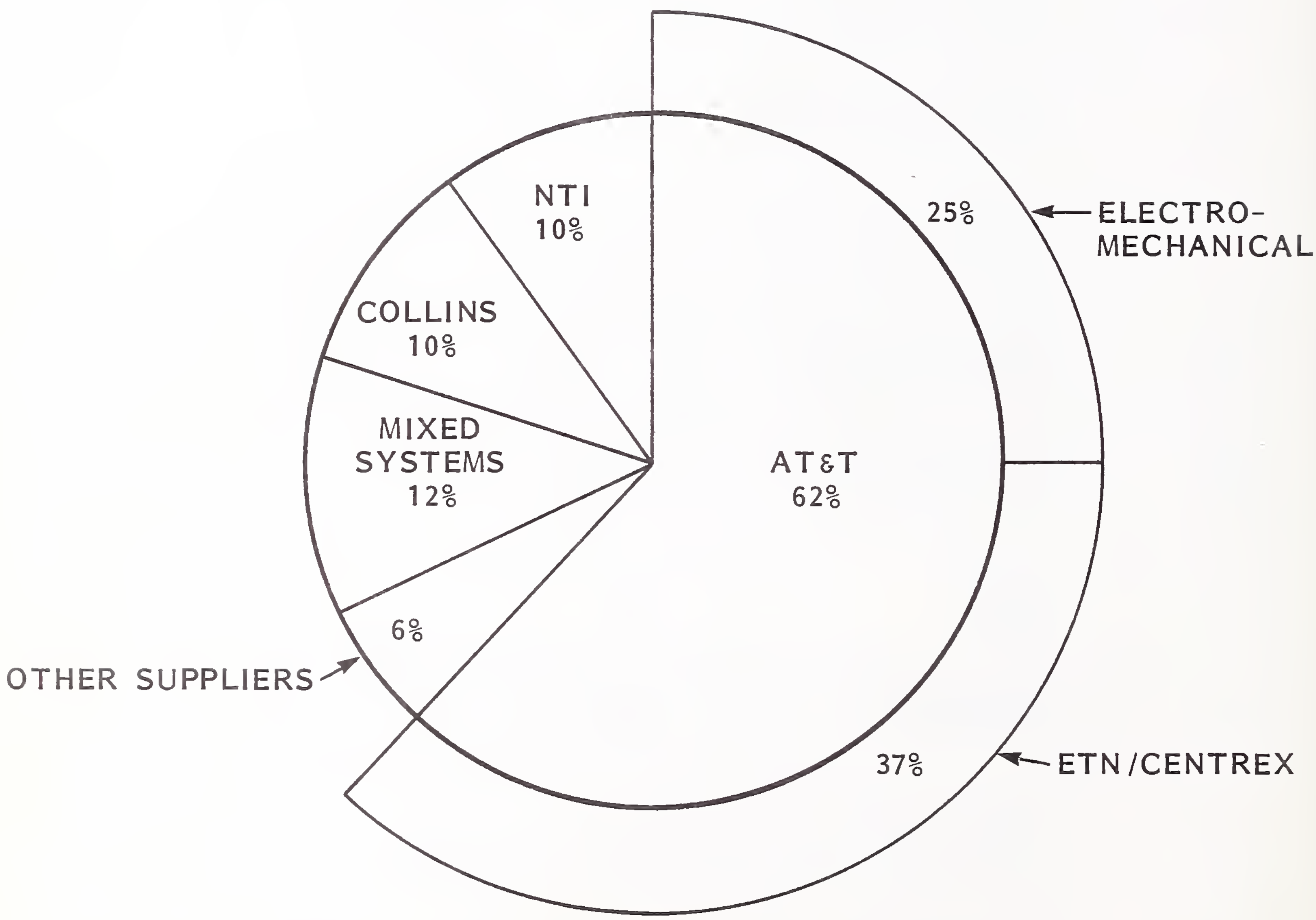
- The average number of PBXs per company studied was slightly over 100. However, since PBXs are related very closely to the number of locations in a company, the data are shown in Exhibit IV-10 as PBXs per location.

  - The average number is 0.33 PBXs per location.

  - It should be noted that some industry sectors appear low. For example, banking has only 0.23 PBXs per location. The reason for this low ratio is that many city banks use a single Centrex to cover multiple branch locations. This cannot be done conveniently with most PBX equipment.

EXHIBIT IV-9

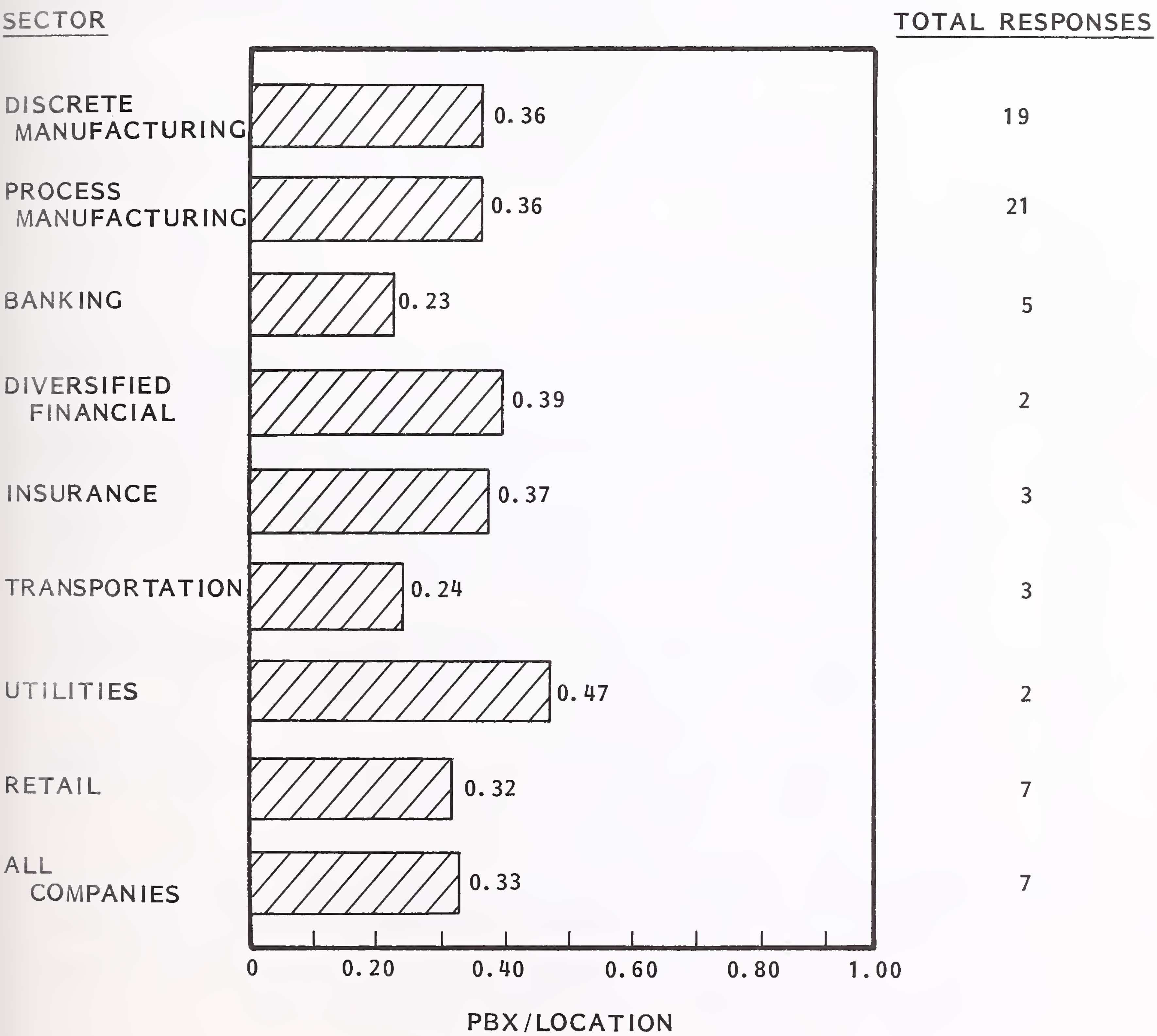
SUPPLIER OF TANDEM SWITCHERS FOR
FORTUNE 500/50 COMPANIES



NUMBER OF COMPANIES = 59

EXHIBIT IV-10

AVERAGE NUMBER OF PBXs PER LOCATION
(INCLUDES CENTREX)



- AT&T and the independent telephone companies have an estimated 65% share of the large company PBX market, or about 40,000 systems. The interconnect industry has about a 35% share, or 20,000 customers.

- As shown in Exhibits IV-11 and IV-12, the very largest companies almost all use interconnect supplied PBXs to at least some extent.

  - One very large company states that "in the last two years since we went to a competitive procurement policy, Bell has not sold one PBX to our company."

3. OTHER VOICE NETWORK ISSUES

- Reasonably good information was obtained from thirty-eight companies on their cost of voice communications. The average cost per minute for intracompany communications was about $0.18. While there were a few companies far outside that range, most of the respondents fell between $0.15 and $0.22 per minute. The companies that were significantly outside that range usually had a very confined geography to their intracompany networks.

  - Offnet communication costs generally tended to be more variable, but the average was in the $0.25 to $0.27 per minute range.

  - Companies with private microwave systems in general did not have good enough data to be able to answer this question.

- Judging grade of service by the P factor proved to be an elusive question on which to get good answers; however, in those cases where the interviewers judged that the answer was in fact being given accurately, the end-to-end P factor for intracompany communication was surprisingly high.

  - In one case a company reported a specific measured P factor of .40 and in a number of cases the P factor was above .20.

EXHIBIT IV-11

COMPANIES USING INTERCONNECT-SUPPLIED PBXs,
BY EMPLOYMENT SIZE AMONG
FORTUNE 500/50 COMPANIES

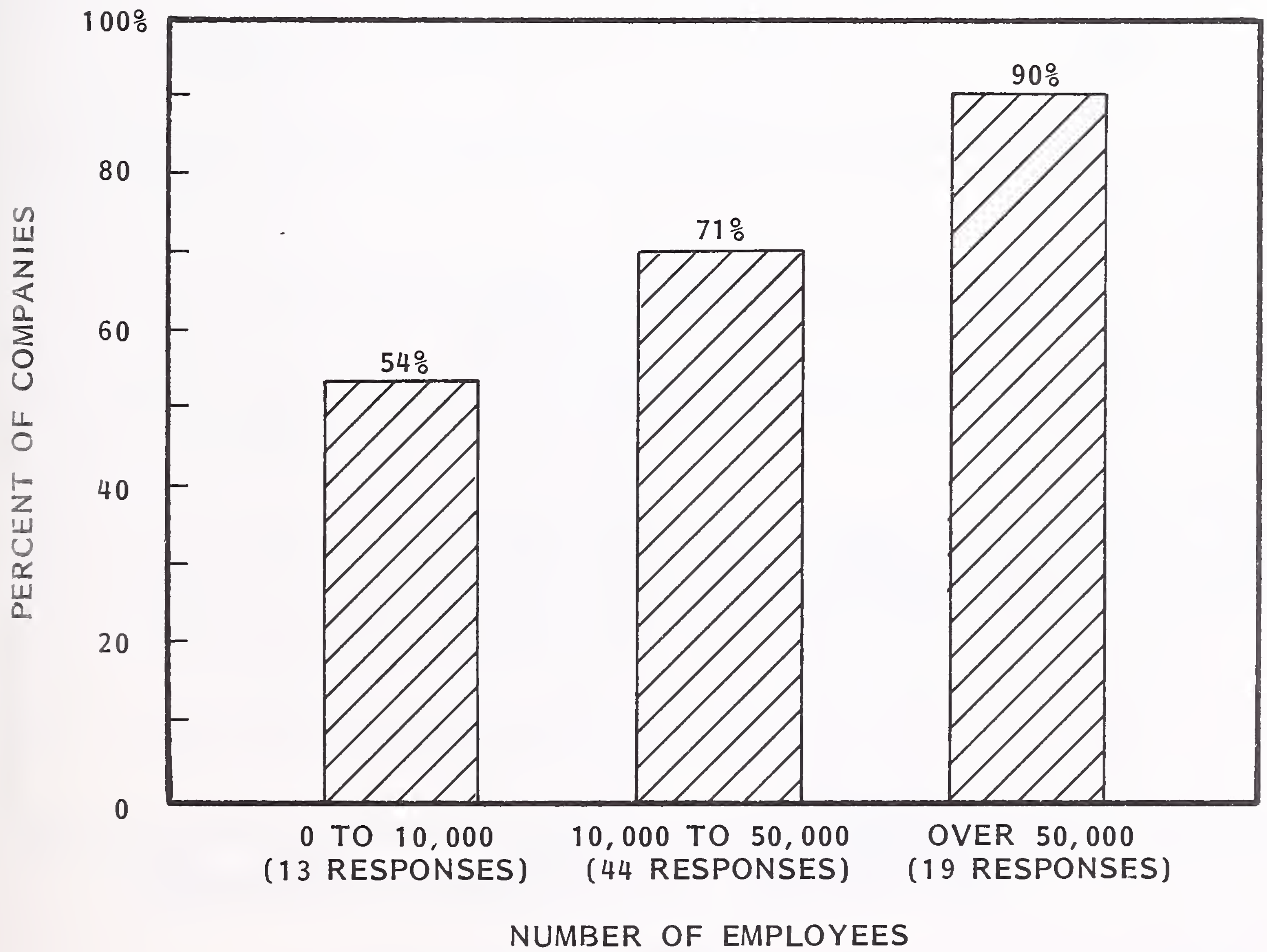
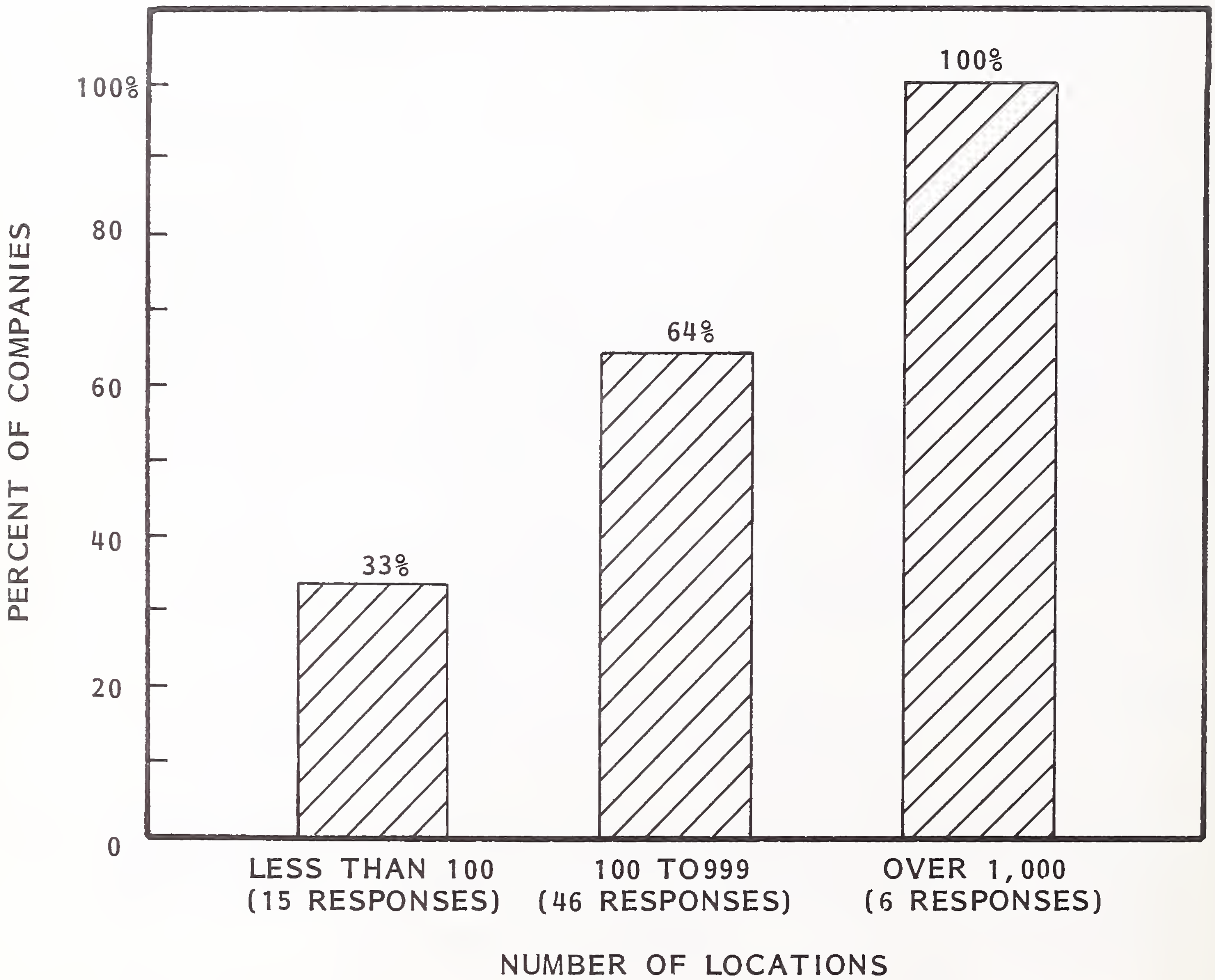


EXHIBIT IV-12

COMPANIES USING INTERCONNECT-SUPPLIED PBXs, BY NUMBER OF LOCATIONS PER COMPANY AMONG FORTUNE 500/50 COMPANIES



- Usually the companies with the high P factors were also the companies with the low intracompany communication costs.

- However, the number of companies with believable data in both of those categories was too small to be able to draw any accurate conclusions.

F. DATA NETWORKS

1. NUMBERS OF NETWORKS

- Most of the large companies had multiple data networks, as shown in Exhibit IV-13.

  - Some of these operated into different computer centers.

  - Some were multiple networks connected into the same computer center.

- The number of actual data networks per company varied from one to one hundred. This last case was surprisingly well documented by the respondent. The data are shown in Exhibit IV-14.

2. IBM AND THE OTHER COMPUTER VENDORS

- If there is any market segment that IBM dominates it is that of data communication network hosts.

  - As shown in Exhibit IV-15, for those companies where there is only one vendor of host computers (which is the case among 77% of the companies interviewed), IBM is the vendor in 72% out of the possible 77%.

EXHIBIT IV-13

AVERAGE NUMBER OF MAJOR COMPUTER CENTERS AND DATA COMMUNICATIONS NETWORKS PER COMPANY AMONG FORTUNE 500/50 COMPANIES

INDUSTRY SECTOR	AVERAGE NUMBER OF COMPUTER CENTERS PER COMPANY	AVERAGE NUMBER OF DATA COMMUNICATIONS NETWORKS PER COMPANY	NUMBER OF VALID RESPONSES
ALL COMPANIES	4.1	4.8	107
DISCRETE MANUFACTURING	5.6	7.8	33
PROCESS MANUFACTURING	5.0	2.9	33
BANKING	2.1	6.3	8
DIVERSIFIED FINANCIAL	1.8	1.8	6
INSURANCE	2.0	2.0	4
TRANSPORTATION	1.4	1.8	6
UTILITIES	2.0	2.5	6
RETAIL	4.0	5.6	11

EXHIBIT IV-14

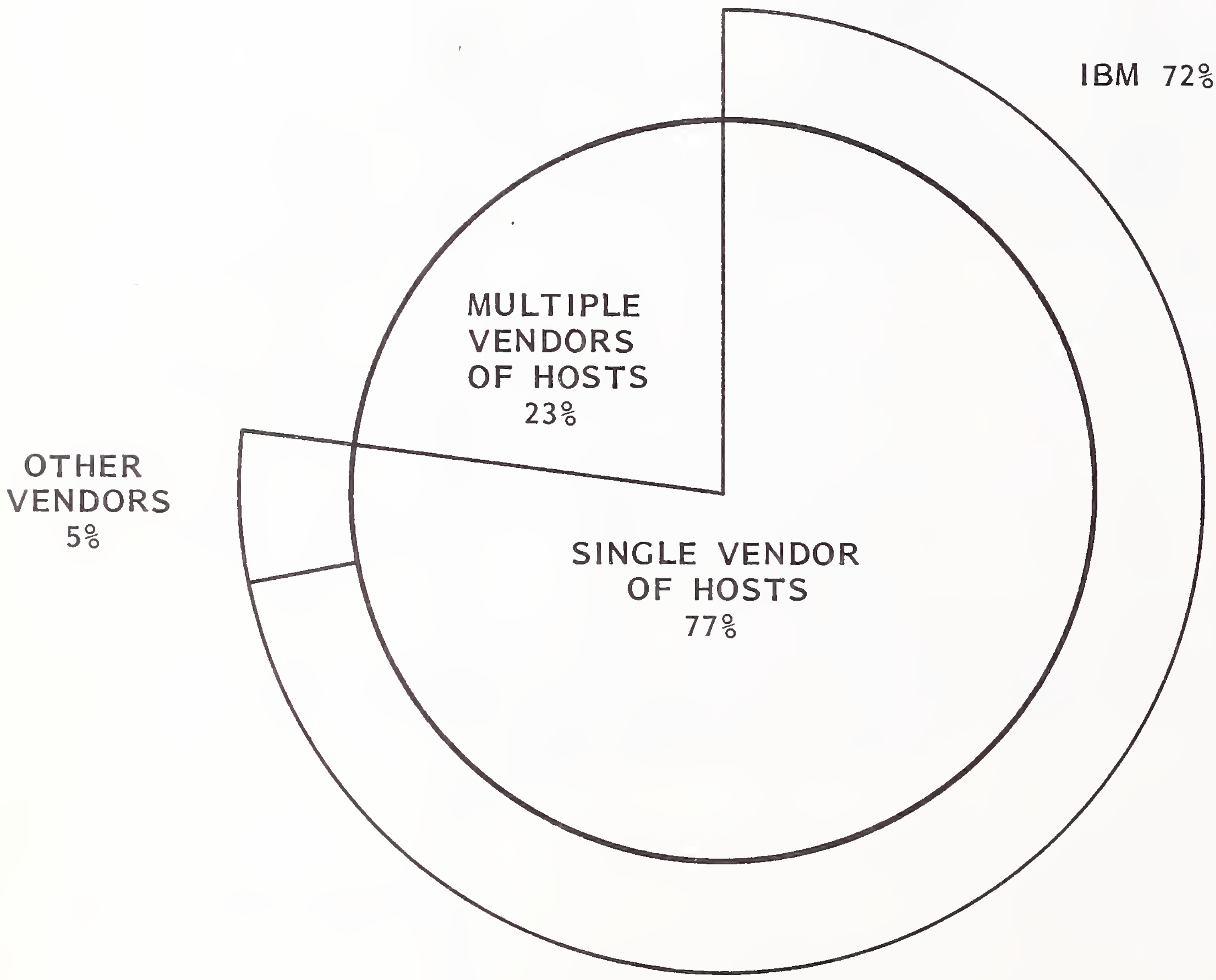
NUMBER OF DATA COMMUNICATION
NETWORKS PER COMPANY AMONG
FORTUNE 500/50 COMPANIES

NUMBER OF NETWORKS	NUMBER OF COMPANIES
1	28
2	18
3	20
4	10
5 TO 10	12
11 TO 25	8
26 OR MORE	1

(97 VALID RESPONSES)

EXHIBIT IV-15

MANUFACTURER OF HOST CPUs
FOR DATA COMMUNICATIONS NETWORKS AMONG
FORTUNE 500/50 COMPANIES



NUMBER OF VALID RESPONSES = 84

- In the 23% of companies that obtained host computers from more than one vendor, IBM was one of these multiple vendors in every case interviewed.

- In summary, IBM is a host computer supplier to 95% of the companies validly sampled in this study.

• Examining this further by industry in Exhibit IV-16, although the individual industry sectors are too small to draw a conclusion, if they are combined, IBM's penetration of the Fortune 50 marketplace is 24 companies out of 30 for an 80% market penetration.

• This IBM dominance can be examined another way. Exhibit IV-17 shows that IBM's dominance is greater in the larger companies.

3. TYPES OF NETWORKS

• Of the companies with data networks (only 4% of the companies sampled do not have a network), 94% have at least one on-line network used for interactive processing.

  - The other 6% have only RJE networks.

  - In most cases, the companies with two or more networks have at least one RJE network.

  - These data come from a sample of 117 valid responses.

• The network configuration is mixed dial-up and dedicated lines in almost every case.

• The average number of communication lines into the network computer centers is shown in Exhibit IV-18.

EXHIBIT IV-16

PENETRATION OF HOST CPU MARKET BY IBM AMONG FORTUNE 500/50 COMPANIES

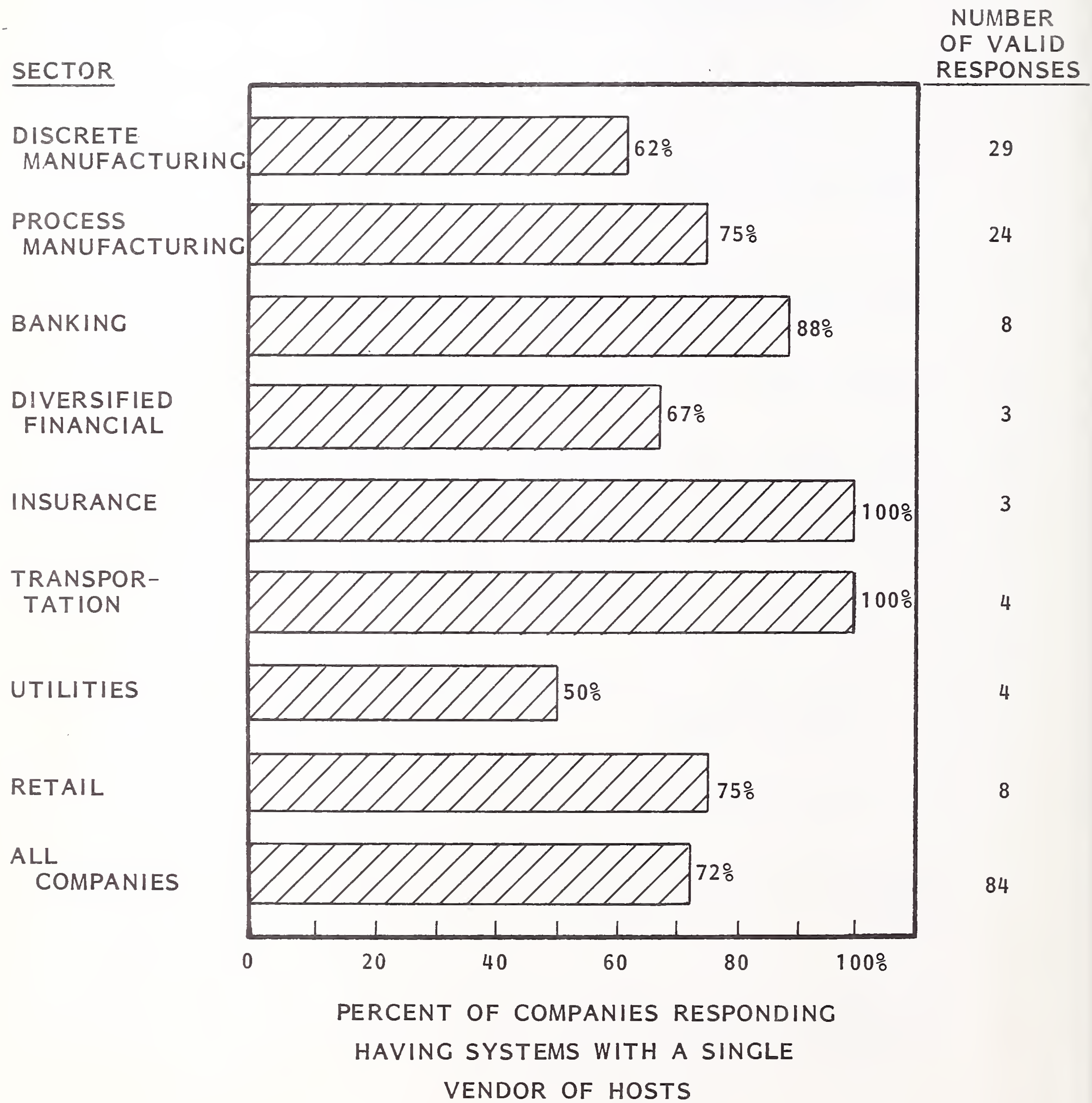


EXHIBIT IV-17

IBM'S PENETRATION OF HOST CPU MARKET, BY NUMBER OF LOCATIONS PER COMPANY, AMONG FORTUNE 500/50 COMPANIES WITH A SINGLE VENDOR OF HOSTS

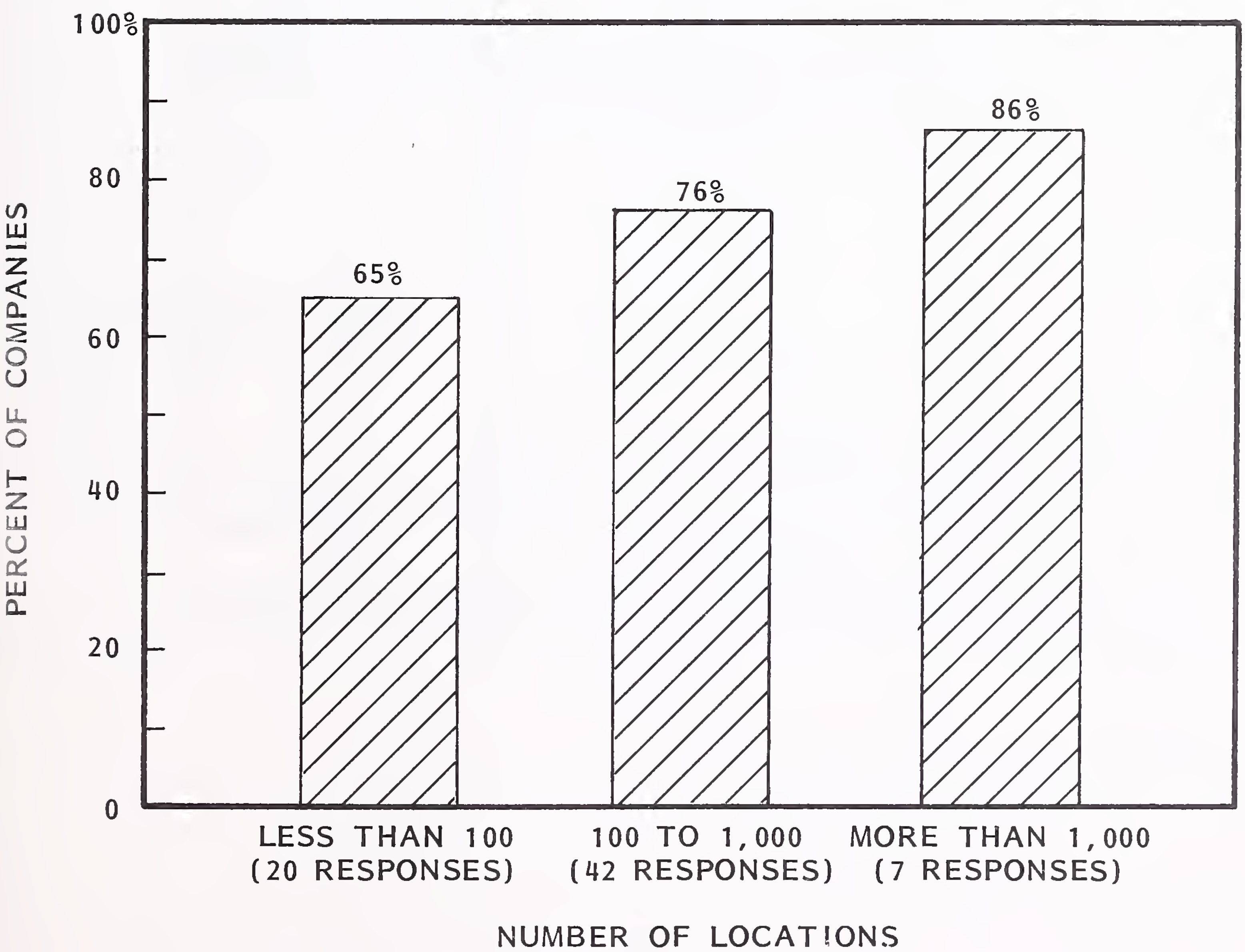


EXHIBIT IV-18

NUMBER OF DATA COMMUNICATION
LINES PER COMPANY AMONG
FORTUNE 500/50 COMPANIES

NUMBER OF LINES	NUMBER OF COMPANIES
0 TO 50	11
51 TO 100	9
101 TO 200	10
201 TO 500	3
MORE THAN 500	3
AVERAGE = 220	36

- Approximately one-third of the companies studied are using some lines with speeds of 56 KBS or faster. However, the quantitative data are insufficient to estimate a total number of such circuits.

4. TERMINALS

- The average Fortune 500/50 company has almost 2,000 terminals installed on the company's data networks. This figure is shown in Exhibit IV-19.

  - The figure is more than double the comparable numbers of terminals estimated in INPUT's 1978 study, "Value Added Network Services."

  - If these two estimates are correct and also comparable (as approximately 75% of the companies interviewed in this study were also interviewed for the 1978 study), the AAGR for total terminals is about 30%.

G. MESSAGE NETWORKS

- Most of the companies interviewed have at least one message network with two or more terminals, as shown in Exhibit IV-20.

- In about 10% of the cases, the companies have an independent message-switching system (or service, in three cases).

- The major application for message networks, even some of the medium to large networks, is external company access, often international.

- Those companies with extensive intracompany networks were the ones most likely to be changing to another system.

EXHIBIT IV-19

AVERAGE NUMBER OF TERMINALS PER COMPANY
AMONG FORTUNE 500/50 COMPANIES

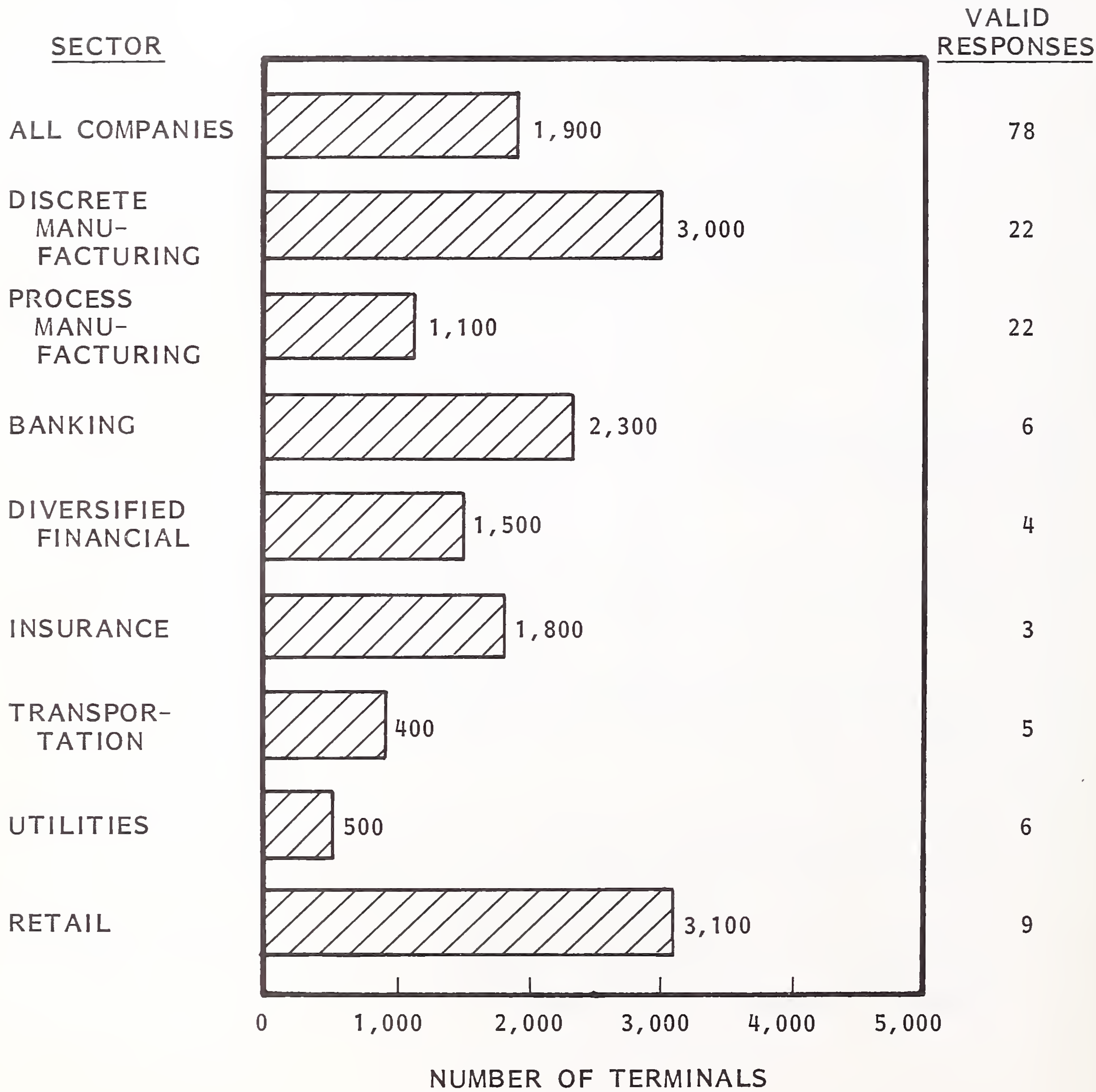
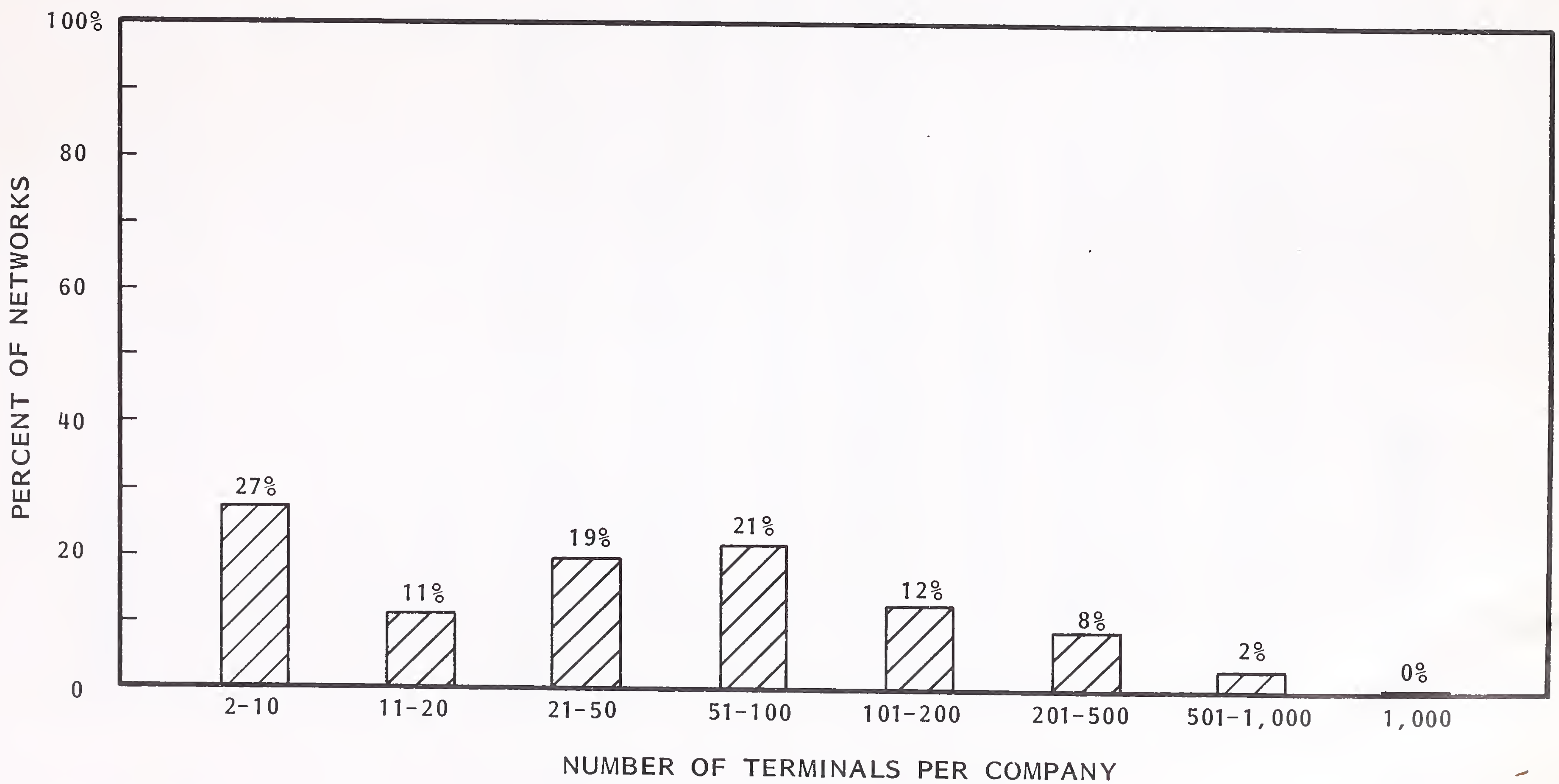


EXHIBIT IV-20

SIZE DISTRIBUTION OF MESSAGE NETWORKS AMONG FORTUNE 500/50 COMPANIES



NUMBER OF RESPONSES = 84

H. FACSIMILE NETWORKS

- Only 5% of the companies interviewed claimed to have no facsimile, and over half of the companies have networks of 100 or more stations.

  - The communication manager was often not directly involved in purchasing the facsimile equipment originally, but is heavily involved in those cases where changes are being considered.

- The size of fax networks is shown in Exhibit IV-21.

  - While fax is not now closely controlled by the communication department, it has grown into a number of exceptionally large networks.

  - The average network has about 100 terminals installed.

  - This compares with a figure of 44 facsimile devices per company in the 1978 VAN study, or an AAGR of 34%.

- In Exhibit IV-22, the applications for facsimile show that a majority of its use is for distinct operational communications. These include:

  - Transactions.

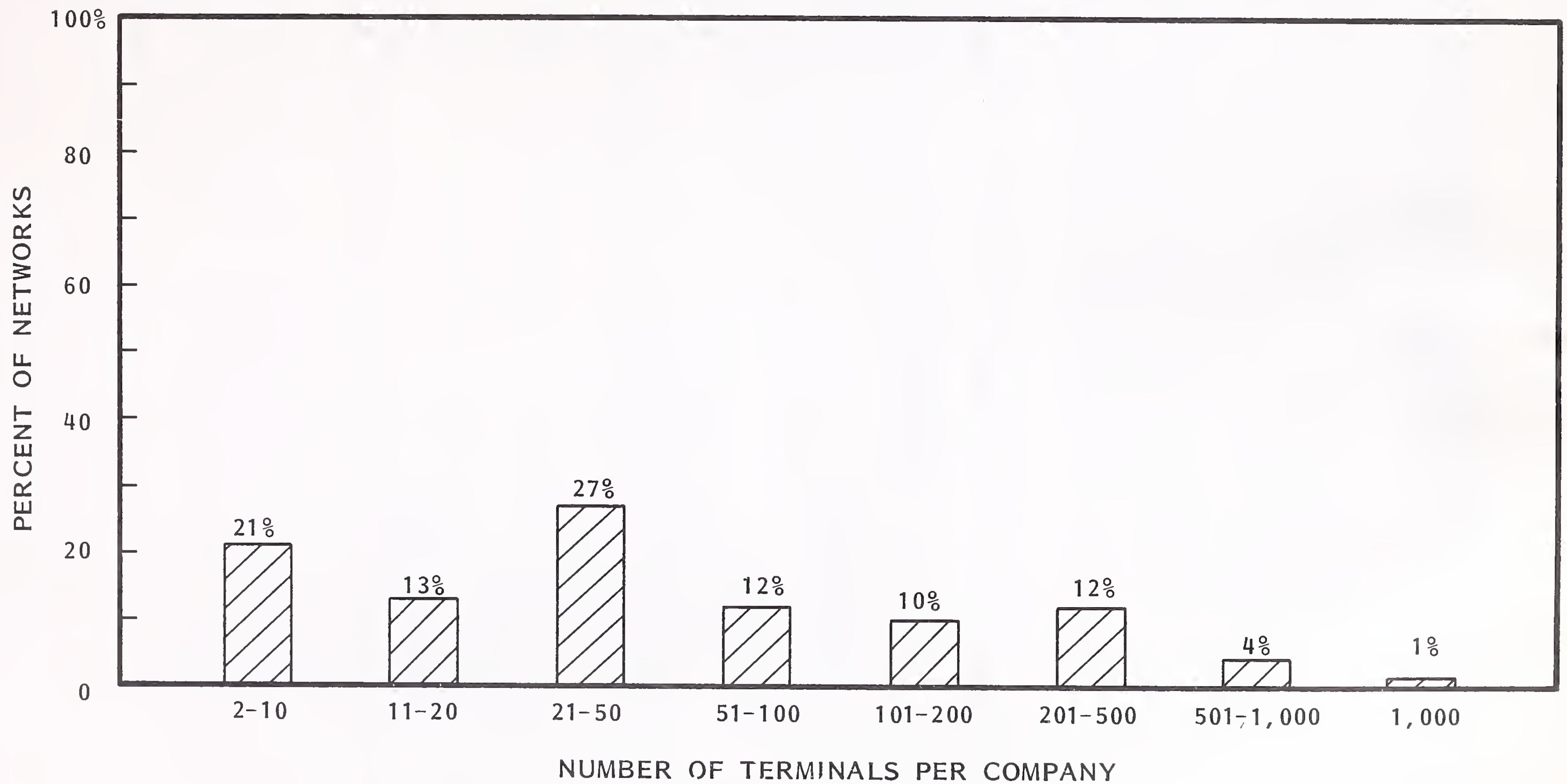
  - Drawings.

  - Reports.

- There are some indications that intercompany communication applications, such as drawings, contracts, etc., are beginning to be sent via facsimile in significant volumes.

EXHIBIT IV-21

SIZE DISTRIBUTION OF FACSIMILE NETWORKS AMONG FORTUNE 500/50 COMPANIES



NUMBER OF RESPONSES = 85

EXHIBIT IV-22

FACSIMILE NETWORK APPLICATIONS AMONG FORTUNE 500/50 COMPANIES

APPLICATION	PERCENT OF MENTIONS
TRANSACTIONS	16%
DOCUMENTS	
- ENGINEERING DRAWINGS	14
- ACCOUNTING REPORTS	19
- PRODUCTION REPORTS	6
- AD LAYOUTS	6
RUSH MAIL	11
MISCELLANEOUS	28

I. INTERCOMPANY COMMUNICATION APPLICATION

- The majority of the communications between a large company and its customers or suppliers is very heavily implemented by the use of voice or mail techniques. More formalized intercompany communication techniques, such as message systems and data systems, were examined in some detail in the course of this study.

1. INTERCOMPANY MESSAGE COMMUNICATION APPLICATIONS

- These applications were generally handled on the Telex/TWX network.

  - While some of these applications consisted of orders and transaction inquiries between companies, the majority of the domestic applications tended to center around communications between manufacturers and their transportation suppliers, particularly railroads or public warehouses.

  - A very high percentage of the intercompany message applications were in the international trade area.

2. INTERCOMPANY DATA COMMUNICATION APPLICATIONS

- In this area there were two distinct levels of data communication system implementation.

  - One of these is in the nature of some limited experiments of interconnecting the data processing systems of manufacturers and their customers or suppliers. There are a number of such cases between very large companies, e.g., within the food industry and within the automobile industry.

- Most of the companies interviewed have a limited set of computer interconnections with their suppliers or with their customers. The major limitation here appears to be a matter of compatibility between these large systems, particularly at the batch transmission level.

• A much more common intercompany data communication implementation is that of the provision of terminal-based services between a company and its network of dealers or distributors.

  - The primary examples are the networks established by the auto companies and the heavy equipment manufacturers for communication with their franchised dealers. These communications are often characterized by information services to these dealers above and beyond the simple transmission of transactions. Such additional services include, for example, inventory control systems, financial management tools and customer service analysis tools.

  - Examples in other industries include the travel agency terminals connected to airline reservation and ticketing systems, correspondent bank terminals and insurance agent terminals connected to the parent organization.

• In many of these cases, the terminal at the dealer's location is in the process of growing into a more powerful data processing system.

  - For example, in the banking industry, many of the correspondent banks are implementing small business computers of their own, reducing the processing and other communications between them and the Fortune 50 bank to which they had been previously connected.

  - Similar trends are occurring in the automobile dealer and heavy equipment industry.

- This subject of user site hardware has been investigated by INPUT in a number of other studies.

- In consumer-related industries, particulary banking and utilities, there is a growing new set of applications calling for direct automated interfaces with consumers; e.g., Bank-By-Phone, and Account Service in utility companies.

J. NETWORK MANAGEMENT CAPABILITIES

- In the course of this study, INPUT found a wide range of capabilities to perform network management functions among the companies surveyed. Generally, companies with larger and more centrally controlled networks had a much more advanced and sophisticated approach to these requirements. But even among the largest of these companies, there is a wide variation between their reliance on vendors to "do a good job" and their reliance on their own ability to manage their own networks.

- In addition, there is a significant difference between voice networks and data networks in terms of the companies' abilities and methods of network management.

  - Generally, the voice networks were managed primarily on the basis of dependence upon AT&T not only to maintain the networks but also to provide the measurement information with which the network could be optimized.

  - In the area of data networks, users tended to be much more self-sufficient, particularly in terms of performing the diagnostic testing of the network elements.

- Many of the companies surveyed, both large and small, tended to rely heavily on a limited number of vendors. In some cases, the companies had established policies oriented strongly toward the single-vendor system concept. Obviously, the single vendor in most of these cases was AT&T for the voice system and IBM for the data communication network.

  - This reliance on a single vendor often tended to be very much geographically related. Companies with major operations in remote locations tended to be very strongly oriented toward the large vendors, particularly AT&T and IBM. Such companies included chemical firms and other heavy industry firms such as steel, heavy machinery, etc. The companies whose operations were in the large cities, such as banks and, to some extent, retailers, tended to be much more willing to deal with both smaller firms and multiple vendors.

V FORECASTS OF CHANGES IN USERS' COMMUNICATION NETWORKS

V FORECASTS OF CHANGES IN USERS' COMMUNICATION NETWORKS

- Ultimately, changes in user networks are the source of all business opportunities for vendors to that marketplace.

- A major conclusion of this study is that users are making changes in their networks currently at a rate faster than has ever occurred in those networks before.

- The changes are occurring in all elements of the networks. This includes voice, data, message, facsimile, electronic mail and all other types of telecommunication networks.

- The scope of the changes ranges from the equipment at the end points, including terminals and telephones, up through all of the nodes and links in the network to the central switching or interface points to other systems, such as data processing systems. A major purpose of this study was to examine the changes and the implication of changes within those networks. It is to that end that the following sections are addressed.

A. THE AGENTS OF CHANGE

- Before discussing the actual changes within the users networks, we must first examine the factors which have created the change. Three types of factors can be distinguished. These are outlined in Exhibit V-1.

EXHIBIT V-1

THE TYPES OF DRIVING FORCES THAT
CREATE CHANGE IN COMMUNICATION NETWORKS

CORPORATE-ORIGINATED FORCES
• CORPORATE GROWTH - TRAFFIC VOLUME - NUMBER OF EMPLOYEES - NUMBER OF LOCATIONS - NUMBER OF TERMINAL DEVICES • NEW APPLICATIONS • CORPORATE ORGANIZATION CHANGES • CORPORATE POLICY CHANGES
EXTERNALLY ORIGINATED FORCES
• PRICE CHANGES • AVAILABILITY OF SERVICES/PRODUCTS • SYSTEM PERFORMANCE CHANGES • VENDOR MARKETING ACTIVITIES
PLAN-ORIGINATED FORCES
• COST IMPROVEMENTS • NETWORK CONFIGURATION CHANGES

- Corporate-created change factors.

- Externally (to the user) created change factors.

- Planned or reactive changes within the communications networks.

1. NEW APPLICATIONS (CHANGE FACTOR = CORPORATE)

- One of the most obvious causes of change in telecommunication networks is the introduction of new applications. This has been a very common and continuing process, but as telecommunications become a more obviously integral part of a company's management structure, new applications are being requested by operating groups at an ever increasing rate.

  - Examples of new applications are the introduction of new point-of-sale systems at check-out counters in non-food retailing chains, and bank-by-phone systems.

2. NEW CORPORATE ORGANIZATION (CHANGE FACTOR = CORPORATE)

- In about 20% of the companies interviewed for this study, the corporation was in the process of undergoing substantial change in organization.

  - Often this was in the nature of an acquisition either of or by the company being interviewed.

  - In a number of cases, it involved some basic changes in the ways companies addressed their marketplaces.

  - One example, occurring in a number of companies, is a significant reduction in the number of places where the company had maintained direct contact with their customers in favor of an increased capability of telephone contact with these customers.

- In almost half of these cases, it represented a simple move of a headquarters location from one site to another.

- Regardless of the type of corporate changes, these changes represented new sets of requirements for the telecommunications network.

3. CHANGES IN CORPORATE STRATEGY/POLICY (CHANGE FACTOR = CORPORATE)

- Many companies interviewed here were in the midst of implementing, or about to implement, major changes in corporate information strategy.

  - Usually this involved some increased level of centralization of such operations, or at least their centralized planning and control.

4. COST IMPROVEMENT (CHANGE FACTOR = PLAN)

- A continuing pressure that causes change in all organizations is the need for improving the cost performance of the existing systems.

  - This, in 1980, is a particularly important agent of change among these network users.

- An interesting point is that this cost improvement issue was usually expressed as "cost stability" or a means of maintaining predictability or control over costs in the face of changing supplier prices, particularly the prices of transmission facilities.

  - Usually this point was raised in the context of concern over anticipated price increases in WATS and in Telpak.

5. GROWTH IN THE NUMBER OF LOCATIONS/EMPLOYEES (CHANGE FACTOR = CORPORATE)

- A long-term cause of change within user networks is the simple growth of the number of locations to be served or the number of employees within the organization. While this usually represents a continuing adjustment, it occasionally gets to a point of saturation where a major change is required.

  - In the companies interviewed, the average rate of long-term growth in both number of employees and number of locations is about 4% AAGR. (This excludes the effects of acquisitions.)

  - Network growth varied widely in the study from company to company and from industry to industry.

  - Network growth in some industries was in fact negative. These industries included the auto industry and some railroads.

  - Network growth was relatively static in a number of other industries, such as retailing and utilities.

  - Growth ranged up to 30% in many industries, particularly those in the oil, chemical and electronics manufacturing areas and in insurance.

6. GROWTH IN THE NUMBERS OF END POINTS (CHANGE FACTOR = CORPORATE)

- Most companies were expecting growth in the number of data terminals anywhere from 15% to, in a few cases, over 50% annually. These expectations are comparable to the 30% AAGR shown in the number of terminals installed per company between this study and the previous INPUT study on this subject in 1978, "Value Added Network Services."

- Growth of telephone instruments was relatively static. Generally, it followed growth of employment in the company but, in a few cases, such as the retail industry, the number of telephone instruments was expected to actually decline, even relative to employment. This is attributable in the retail industry to the centralization of check-out locations.

- Message terminals, in general, are being reduced in number within the large companies primarily by reason of being converted to other methods, usually data networks.

- Facsimile devices, while exhibiting growth rates comparable to that of data terminals, showed even more dramatic changes in the types of facsimile devices.

7. GROWTH IN TRAFFIC VOLUME (CHANGE FACTOR = CORPORATE)

- In general, the growth of traffic volume followed the growth in terms of numbers of end points; that is, the traffic per end point did not seem to be changing. There are two exceptions to this pattern:

  - Telephone traffic to and from consumers in industries such as banking, utilities, airlines, credit operations of large companies, etc., is expected to increase sharply.

  - Batch data terminals, many of which are distributed processors, are not only expanding in number but the traffic volume per device is also increasing rapidly.

8. CONFIGURATION CHANGES (CHANGE FACTOR = PLAN)

- By far the most dramatic changes that were observed during this study were changes in the configuration of existing user networks. These changes occur in a number of different directions, which have been classified below as centralization, distribution and integration.

- Centralization in the context of this study implies three things:

  - A single corporate voice network.

  - A single corporate data network, or a least a reduced number of networks.

  - A reduced number of major computer centers.

- About 90% of the companies have plans to centralize their data networks.

- About 80% of the companies have plans to centralize their voice networks.

- This does not yet imply an integrated voice-data network, but many of these companies are thinking in that direction.

- It does imply a single data network, usually with message capabilities and a separate, single voice network.

- The companies that were not planning in the direction of centralization were generally those in the highly decentralized organizations, particularly those referred to as "conglomerates."

  - This interesting anomaly between voice and data centralization is attributed to the relative strengths of the voice and data communication management organizations and, as noted earlier, the general applicability and acceptablity of the public-switched voice network.

- As shown earlier in Exhibit IV-3, there are 19 companies with five or more major computer centers.

  - Of these 19, 15 were planning to reduce the number of centers, and many were well into such a process.

- Of the four companies that did not have such plans, all were highly decentralized organizations.

- There were no companies planning to expand the number of major centers, with the exception of a few new venture-type situations.

• There does appear to be an optimum number of major computer centers in these large data networks.

  - This number is definitely more than one because of security or fallback reasons.

  - Many of the companies with a single, very large computer center were working on plans to implement a second center for precisely this reason.

• Many of the very large companies with large natural nodes of operations in different sections of the country have settled on a three or four major center type of data network. The aircraft companies are good examples of this configuration.

• Centralization of voice networks has largely already been accomplished and the change process now is more in the nature of modernizing the network switching systems.

• Again, there appears to be an optimum number of network switching nodes and this number is highly dependent on the corporate geography.

  - For fully nationwide companies, the number is about four.

  - This number reduces as the geographic operations of the company reduce.

- There is no serious consideration about fallback capability for the switching centers other than parallel or host standby control processors at the switching center.

- Distribution is another configuration trend being implemented simultaneously with centralization.

  - This trend, now visible only in data networks and termed distributed processing, places some level of processing capability close to the end user.

  - This distributed processing trend is directed primarily at putting processing capability at local data network nodes rather than all the way to the user terminal.

  - The processing functions being distributed to these local nodes are those functions which are required only at the local site and not elsewhere in the network.

  - One user described the philosophy behind this combined distributed/centralized data network as: "Render unto Caesar the things that are Caesar's and to the terminals the things that will kill your budget."

- The subject of network integration will be discussed later in this section.

9. AVAILABILITY OF NETWORK SERVICES (CHANGE FACTOR = PLAN)

- One major factor in causing change in telecommunication networks is the availability of a product or service.

- A good example of this is the simple habit-forming characteristics of telephone usage. A readily available and convenient-to-use telephone (particularly one where the user does not get a charge back) creates a significant amount of traffic which might not have existed had the telephone been less available.

- A better example of such availability as an agent of change in another market is the use of the office copier.

• Within this study one of the best examples of the point that "availability creates change" is the use to which a major manufacturer put a multiple earth station satellite network.

  - This company implemented a three location satellite network operating at 112 KBPS. The reason for putting the network in place originally was the requirement to perform RJE transmissions among three large manufacturing and engineering locations scattered around the country.

  - Once the network was in place and being used some four hours per day for the RJE applications, additional equipment was added to the stations to perform slow-scan video teleconferencing operations.

  - The availability of this new service on that network created a traffic volume of some three hours per day of slow-scan video teleconferencing which had not been foreseen but which proved to be very valuable to the engineering departments involved in each of those three separate locations.

10. CONTROL (CHANGE FACTOR = PLAN)

• On the opposite side of this availability question is control or the restriction of the availability of services. This can also be a significant agent of change in the network plans.

- Many users in this study and other studies of the subject have found that the recording and charge back of calls made by individual stations has a tendency to reduce traffic by eliminating casual or personal calls from the business telephone network. Reduction in call volume in the 20% range has been reported in some instances.

11. PRICE CHANGES (CHANGE FACTOR = EXTERNAL)

- A point of particular concern among the companies interviewed was the expected changes in a number of key telecommunication services offered by Bell, specifically the Telpak tariff and the WATS tariff.

  - Many of these user organizations have very substantial expenditures in both of these categories and anticipate their costs rising dramatically with the changes in price of these two services in particular.

  - The resulting actions on the part of the users are not so much to obtain a direct cost reduction to offset these changes but more to find some system mechanism whereby these and future anticipated changes might be compensated for and provide more stability to the network cost budgeting problem.

12. SYSTEM PERFORMANCE CHANGES (CHANGE FACTOR = EXTERNAL)

- Another substantial reason presented by users for creating changes of various sorts within their network is the change in performance being obtained from vendors. While this usually related to declines in performance from the transmission service carriers, it occasionally reflected an improvement in system performance on the part of other vendors, in particular the manufacturers of intelligent network node equipment such as multiplexers and PBXs.

13. VENDOR ACTIVITIES (CHANGE FACTOR = EXTERNAL)

- With new kinds of capabilities the activities of the vendors and particularly of the vendors' marketing organization, have a very sizable impact on the probability of change within a specific user organization or within an industry.

  - A good example of this effect is the high degree of success achieved by GTE-Telenet in its promotion of Telemail, a new electronic mail type service introduced in May 1980. This service, which has largely been sold to functional departments such as sales management, was almost certainly not perceived as a requirement by the ultimate purchasers until the activities of the vendor created the need in the functional manager's mind.

B. CHANGES IN VOICE NETWORKS

- The changes which users expect to be making in their voice networks are primarily concentrated in the two network elements related to switching. These are:

  - Network switching.

  - PBX.

- In the users' planning, major changes in the other network elements, transmission and telephone instruments, are further off in time.

1. CHANGES IN NETWORK SWITCHING

- As noted earlier, most of the planned changes in network switching are in the nature of modernization. This very general term includes:

- Control, in the form of improved usage data and in the form of user access control.

- Cost reduction, in both the cost of the switching equipment itself as well as in the ability to interface with a choice of lower cost transmission services than those offered by AT&T.

- Improved service without increased cost. This would cover the availability of such features as uniform or simplified network numbering, trunk reconfiguration for time of day, lower noise switching for use by data terminals, etc.

- As shown in Exhibit V-2, about 40% of the companies have plans to make changes in their network switching systems.

  - Surprisingly, it is mostly the companies with the highest level of network switching capability in place, the users of CCSA/EPSCS or tandem networks, which are planning to make changes.

  - Over half of these companies are planning to make changes whereas only one third of the PBX tie-line networks and less than one fifth of the non-network users are planning to change.

  - As with the data versus voice network changes referred to earlier, this anomaly is attributed to the strength and/or level of control of the communications manager in various types of organizations.

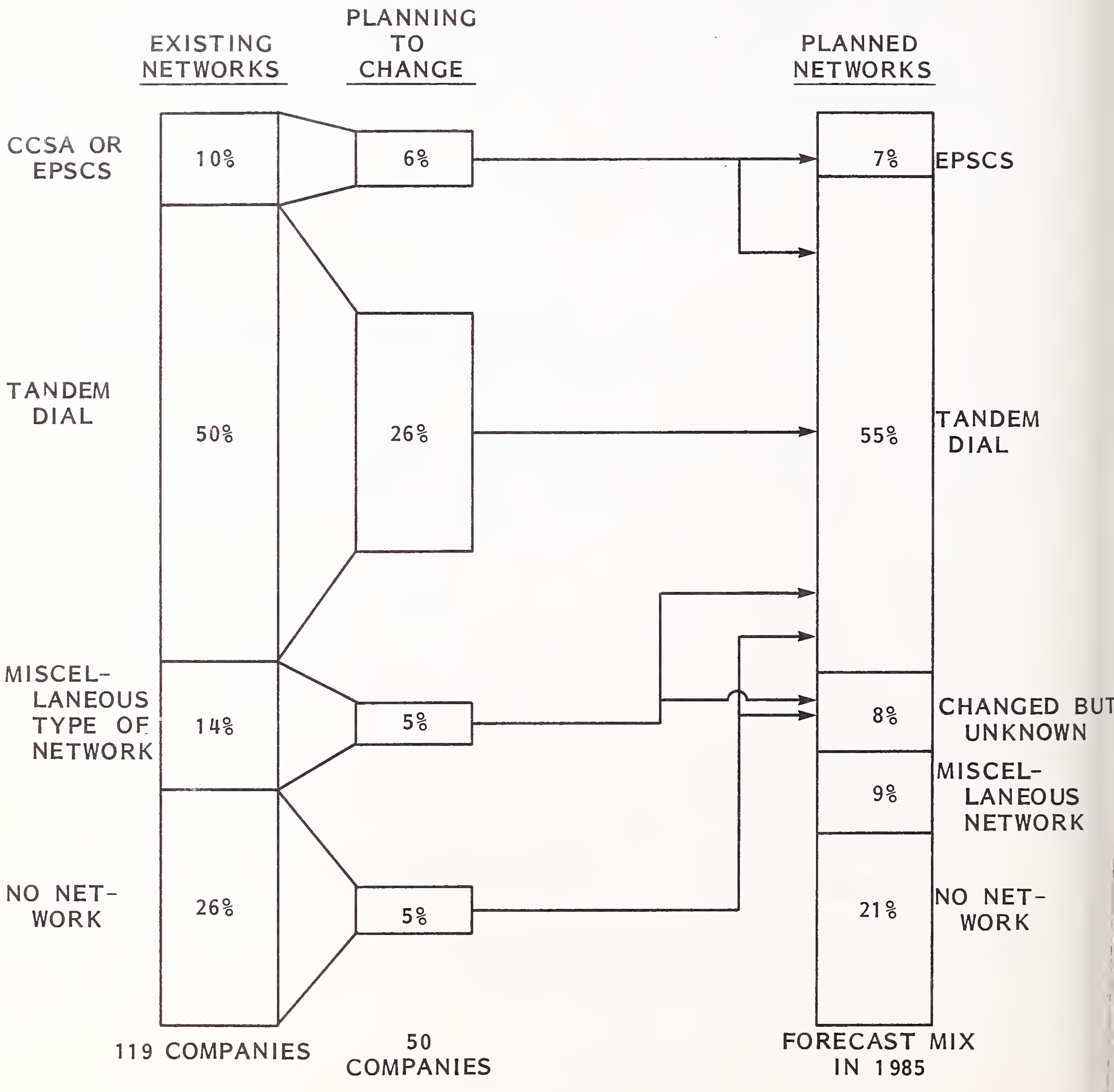
2. CHANGES IN PBXs

- The primary changes which users are making or planning to make in PBXs fall into two categories:

  - Conversion to electronic PBXs.

EXHIBIT V-2

PLANNED CHANGES IN VOICE NETWORKS AMONG FORTUNE 500/50 COMPANIES



- Conversion to interconnect provided PBXs.

- The electronic PBX is being planned for largely the same reasons as the network switches. They are:

  - Control, as in user access and call detail recording.

  - Cost reduction, in that the new equipment is generally lower in original cost and in operational cost than older systems.

  - Expanded features, particularly those which can improve user satisfaction without increasing the cost.

- The interconnect growth is largely attributable to the lower cost of interconnect provided equipment as well as more advanced features.

- It should also be pointed out that the interconnect PBX market, while it has undergone many shakeouts in the last decade, is still a very "salesy" business and much of the selling is on features, some of which, while interesting, are ultimately not effectively usable for a variety of reasons. Some examples are:

  - Call Queuing. When an individual places a call and the destination telephone is unavailable, call queuing can hold the call for later placement and then call back the originator when it can be placed. When the call ultimately goes through, the originator, having been involved in other things in the interim, may momentarily forget who he or she was calling or why.

  - Remote Peripherals. As shown earlier, many companies have multiple locations near to each other and potentially serviceable using a single PBX with a remote peripheral shelf in the other building. The problem is that to make this method economically attractive, the connection

between the two buildings must be a wideband connection such as TI carrier spans. For all practical purposes, these are not available in most locations.

- Data Capability. The use of the PBX to connect data terminals to each other, to colocated computer centers or to a pool of modems is a particularly attractive idea. The problem is that the current PBX manufacturers solutions don't work well as yet.

- The point is that the interconnect PBX market is still very much a vendor-driven market with all of the good and bad aspects that implies.

C. CHANGES IN DATA NETWORKS

- The companies planning to make significant changes in their data networks (about 80% of the companies studied) can be placed into three categories as follows:

  - Specific changes decided.

  - General direction of change decided but specifics not yet laid out.

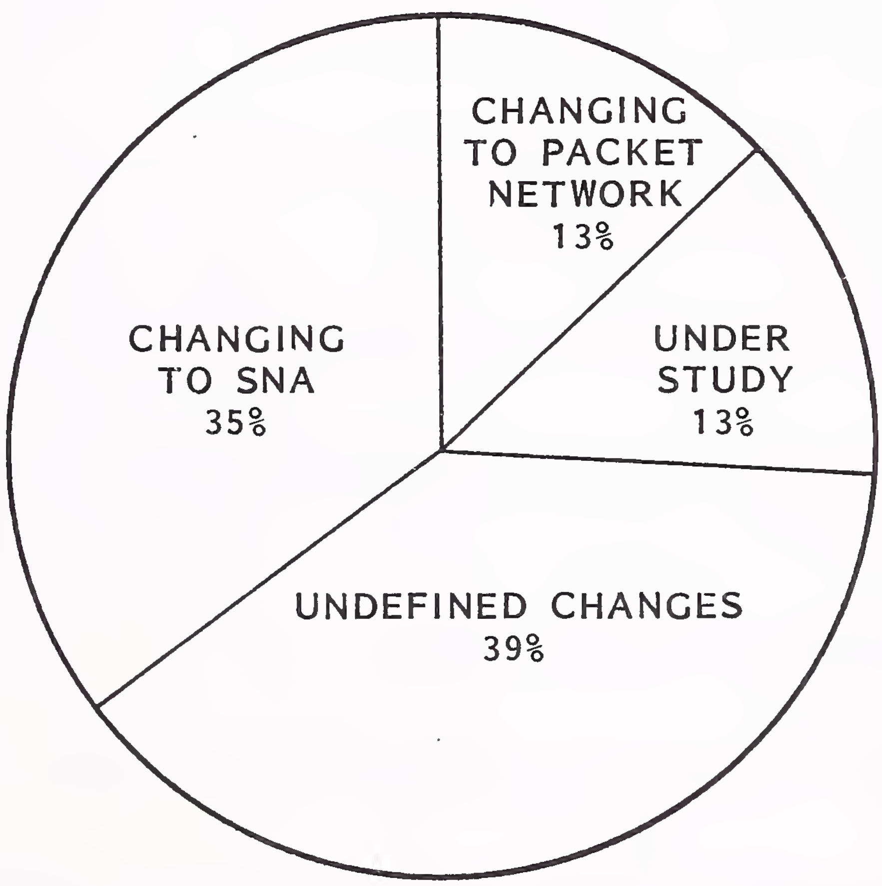
  - Changes will be planned and made as a result of a study presently under way or about to begin.

- This is illustrated in Exhibit V-3.

- In most of these companies, but particularly in the companies studying the problem, the changes are regarded as significant network changes and not simply the adjustments for growth or for additional applications which are more or less continuing processes.

EXHIBIT V-3

FORTUNE 500/50 COMPANIES PLANNING TO MAKE SIGNIFICANT DATA COMMUNICATIONS NETWORK CHANGES



- 72 COMPANIES ARE PLANNING CHANGES
- 15 COMPANIES ARE NOT PLANNING CHANGES

- The reasons for making the changes were somewhat difficult to pin down, but in general were related to growth.

  - In some cases the growth was specific; that is, more terminals, new applications, etc. High-speed (56 KBPS) media terminals were a major factor.

  - In most of the cases the growth was future growth and/or flexibility.

  - There were a number of other companies where the reason for change was much more specific, for example, corporate reorganizations.

- Essentially all of the companies were starting from a basic hierarchical data network as illustrated in Exhibit V-4.

I. COMPANIES WITH SPECIFIC CHANGES PLANNED

- About half of the companies planning data network changes have made their decisions about how and what changes are to be implemented.

- The changes decided upon are either:

  - A full SNA network, as illustrated in Exhibit V-5.

  - A distributed minicomputer based network, as illustrated in Exhibit V-6.

  - A host-independent network using packet-switched trasmission techniques, as illustrated in Exhibit V-7.

- The companies going with SNA are all IBM shops already, although there were three companies among them which are multiple vendor shops.

EXHIBIT V-4

TYPICAL BASIC HIERARCHICAL DATA NETWORK

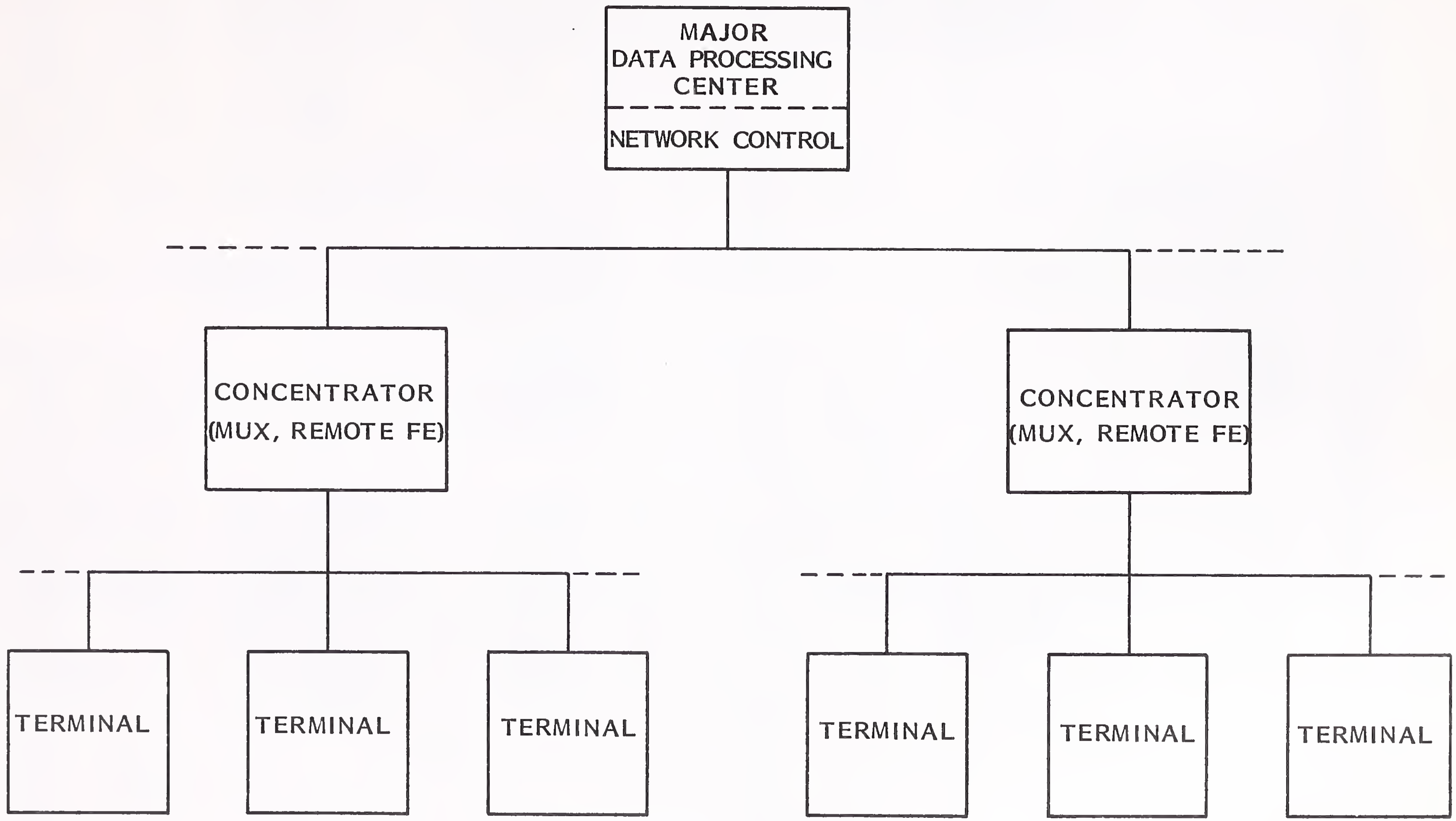


EXHIBIT V-5

TYPICAL SNA INTEGRATED DATA NETWORK

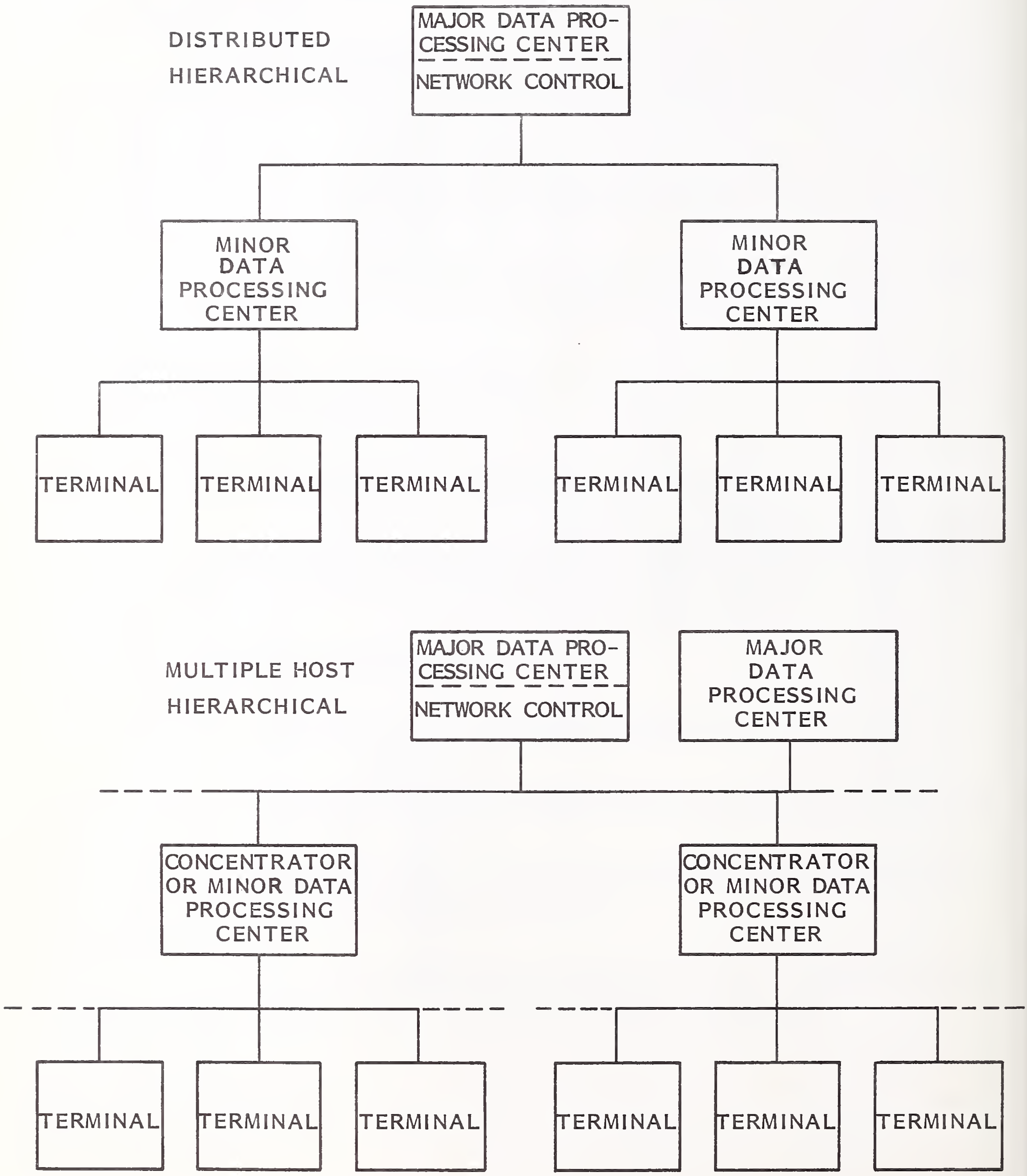


EXHIBIT V-6

TYPICAL DISTRIBUTED, MINICOMPUTER-BASED NETWORK

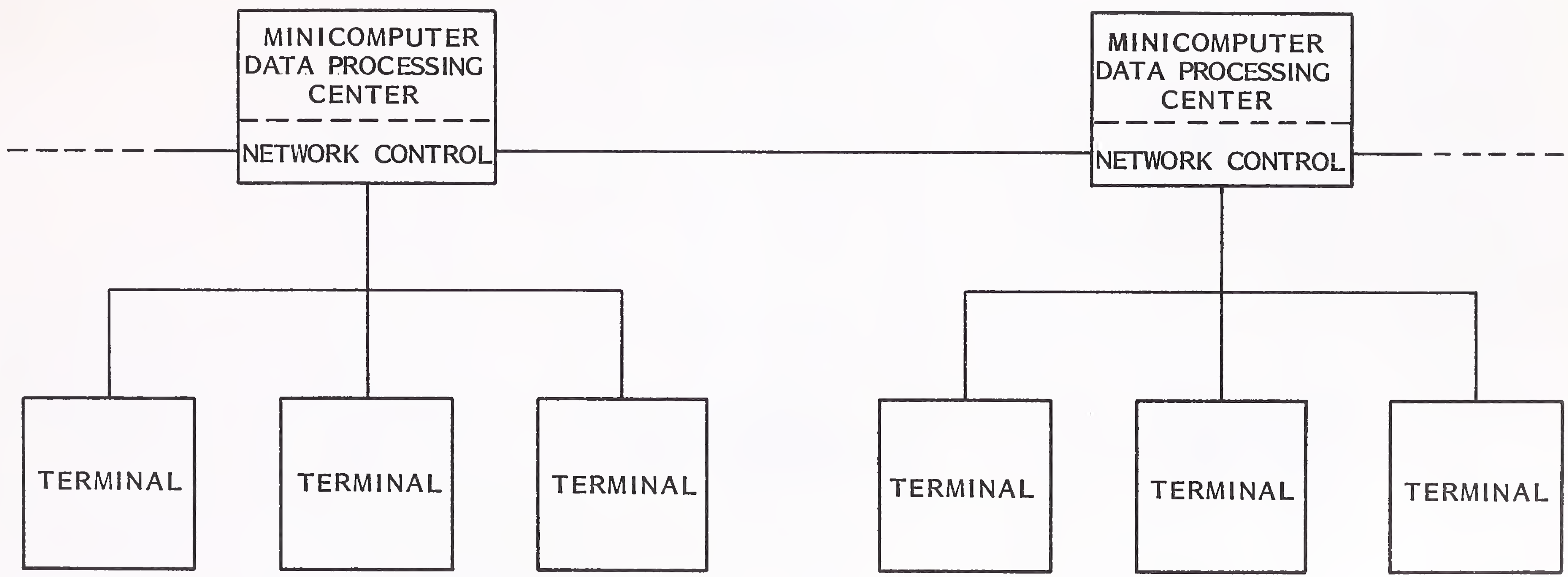
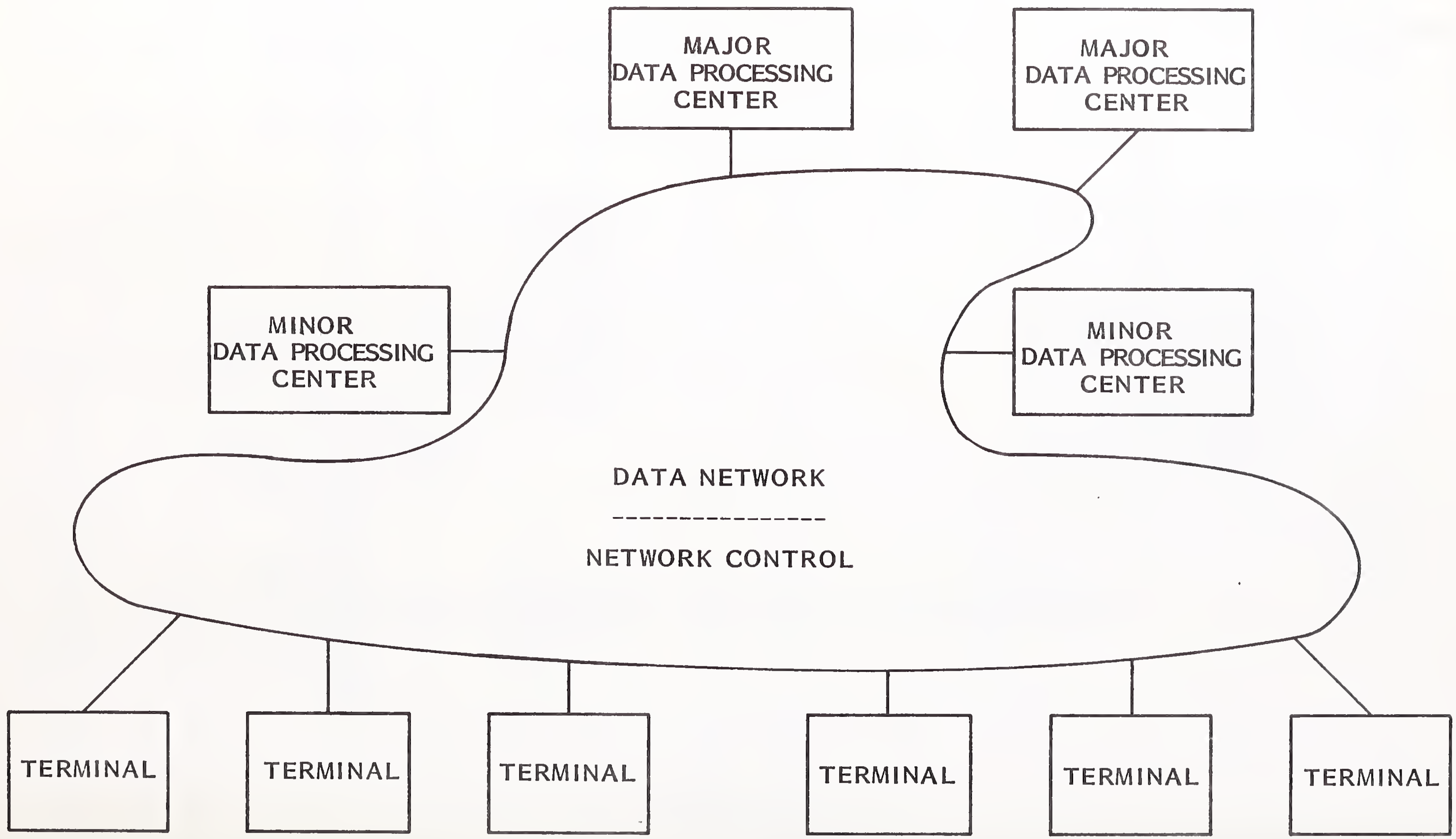


EXHIBIT V-7

HOST-INDEPENDENT DATA NETWORK



- In the case of these three multiple host vendor shops and in a few more multiple location IBM computer centers, the SNA network was not being planned to interconnect all centers.

- These are, however, the exceptions. In most cases, the SNA approach was intended to accomplish a multiple network integration objective.

• The ten companies in the study going with packet-switched networks defined their own plans as a "packet-switched network." This term needs to be qualified.

• A packet-switched network usually means two basic things to these ten companies:

  - A host-independent data communications network.

  - An intranetwork communication protocol based on packet-switching technology, including the use of the X25 standard.

• A packet-switched network does not necessarily mean:

  - Packet interfaces to the hosts or to the terminals.

  - Dynamic Routing.

• It may and usually does include alternate path routing.

• In seven of these companies, the node processor had been selected. These included:

  - Telenet.

  - Tandem.

- DEC.

- TI.

- Perkin-Elmer.

- This is obviously a wide range of processors and it also makes the point that, with many of these companies, while the initial implementation is the use of the node processors as only data communication processing, the ultimate plan is to perform distributed processing applications on these same units.

  - This is particularly true in the case of the two companies planning to use Tandem processors.

- As shown in Exhibit V-8, these ten companies plan a total of 85 node processors with an average of about 350 terminals per processor.

- Two of these ten companies had only one computer center, but the others all had widely separated multiple computer centers.

  - One of the two companies with only one computer center had plans to establish a second center in the near future.

- All but one of these ten companies were users of IBM mainframes, and four of them were users of only IBM mainframes.

  - The IBM users all had SNA implemented, at least to some extent.

2. COMPANIES WITH UNDEFINED CHANGES BEING PLANNED

- Undefined is perhaps too vague a term for these changes because the companies do have fairly specific objectives toward which their networks will be redirected. These objectives fall into two categories:

EXHIBIT V-8

CHARACTERISTICS OF FORTUNE 500/50 COMPANIES
USING, OR PLANNING TO IMPLEMENT,
PRIVATE, PACKET-SWITCHED NETWORKS

ITEM	NUMBER	PERCENT OF SAMPLE
COMPANIES	10	11%
IDENTIFIED NODES	85	UNKNOWN
EMPLOYEES	526,000	15
TOTAL LOCATIONS	2,830	10
MAJOR OF LOCATIONS (> 1,000 EMPLOYEES)	65	17
TERMINALS	32,000	24

- A single network.

- A distributed network.

- While not specified in the same level of detail as the previous "specific change" companies, these less specific companies, which comprise almost 40% of the companies planning change, tend to mean much the same things with their objectives.

- The single network firms generally are IBM-oriented companies that are not yet ready to made the conversion to SNA but probably will in the near future.

- The distributed network firms are thinking along the same lines as the packet-switched network firms, with two exceptions:

  - They have not yet made a decision.

  - Their distributed network objective derives more from the desire to place processing capability close to the user than from a desire for a host-independent network.

- Many of these firms aiming toward a distributed network will implement it using SNA.

3. COMPANIES STUDYING NETWORK CHANGES

- Studies can be serious precursors to a thorough job or they can be a technique for postponing a decision.

- Of the ten companies studying data network changes, all or pratically all appear to be performing a serious study of what they regard as a major decision.

- This is, of course, difficult to evaluate, but it relates to the overall qualifications of the communication department, a subject discussed later in this report.

- Another element of this evaluation is the stated reason for conducting the study.

• The companies' stated reasons for conducting a serious study of communications network requirements (and some of these companies are studying not just data but also voice, message and fax video conferencing, etc.) are the long-term needs to provide a wide range of information services for management of the company.

• The studies are usually initiated at a level higher than the communication departments, and in some cases at the executive level.

D. CHANGES IN MESSAGE SYSTEMS

• The major changes planned for message systems are to combine them with data networks, as shown in Exhibit V-9.

• The messsage networks that are most being considered for conversion to data networks are those where:

  - The primary application is intracompany as opposed to intercompany.

  - The company is in the process of studying its data networks and other communication requirements.

• The second most significant type of change mentioned is that of improved terminals. These improvements fall into two categories:

EXHIBIT V-9

TYPES OF CHANGES THAT
USERS PLAN TO MAKE
IN MESSAGE NETWORKS AMONG
FORTUNE 500/50 COMPANIES

TYPE OF CHANGE	PERCENT OF MENTIONS
TERMINAL IMPROVEMENTS (e.g., CRTs, MULTIFUNCTION, etc.)	19%
UNDER STUDY	7
CONVERT TO OTHER MEANS	
- TO DATA NETWORK	52
- TO CWP OR ELECTRONIC MAIL	12
- TO FACSIMILE	10

- Terminals that are easier for the operators to use, particularly CRTs.

- Terminals that can perform multifunctions, including access to data systems and remote computing sytems, access to a number of message and/or electronic mail services, etc.

E. CHANGES IN FACSIMILE NETWORKS

- Other than the relatively rapid growth in facsimile devices mentioned earlier, the primary change users are making in their facsimile networks is the conversion to higher-speed and/or digital terminals, as shown in Exhibit V-10.

- Also mentioned earlier was the fact that the communications department is apparently now taking a stronger interest in facsimile and its uses and operations.

- The existing fax networks have been largely initiated and grown under the auspices of functional departments such as sales or engineering.

- Both the size of the networks and the growing ability of facsimile equipment to be put on a systematic footing have placed the communications managers in the posture of trying to get control over these networks.

F. CHANGES IN ELECTRONIC MAIL SYSTEMS

- A clear pattern of change in electronic mail systems was not discernible in this study.

- While many companies have installed various types of electronic mail systems and services, as shown in Exhibit V-11, and the number of such installations is

EXHIBIT V-10

TYPES OF CHANGES THAT USERS PLAN TO MAKE
IN FACSIMILE NETWORKS AMONG
FORTUNE 500/50 COMPANIES

TYPE OF CHANGE	PERCENT OF MENTIONS
SPECIFIED CHANGE	
- HIGHER-SPEED TERMINALS	32%
- DIGITAL TERMINALS	11
- AUTOMATION (e.g., AUTO-DIAL, UNATTENDED OPERATION, etc.)	14
- FAXPAK	5
- STORE AND FORWARD	5
- OTHER	4
UNDER STUDY	11
CONVERT TO OTHER MEANS	
- TO DATA NETWORK	7
- TO CWP OR ELECTRONIC MAIL	7
- TO OTHER	4

EXHIBIT V-11

TYPES OF ELECTRONIC MAIL SYSTEMS INSTALLED AMONG FORTUNE 500/50 COMPANIES

SYSTEM TYPE	PERCENT OF COMPANIES
WORD PROCESSOR BASED	10%
- SHARED PROCESSOR (WANG)	
- STANDALONE	
IN-HOUSE COMPUTER SYSTEMS	18
- DATA NETWORKS (TSO, CMS, SCRIPT)	
- EM PACKAGES (COMET)	
REMOTE COMPUTER SERVICES	8
- ANNOUNCED (COMSHARE, STS)	
- INFORMAL	
ELECTRONIC MAIL SERVICES	10
- TELEMAIL	
- ON-TYME	
- COMET	

growing, there are so many different ways in which these capabilities are implemented that patterns of growth are very unclear.

- One thing that is clear is that while the communication organization is involved with studying this process, along with other departments of the company, the functional groups are implementing electronic mail systems on their own.

- An analogy might be made here to the facsimile networks just discussed. There also was a situation where the functional departments initiated the networks and the communication departments are now trying to get the situation under control.

G. NETWORK INTEGRATION

- One of the primary objectives of this study was to examine the subject of network integration and to establish how and how fast this integration was occurring, if at all.

- Integration of multiple data networks, a situation prevalent among large companies, is the clearest trend.

  - The reduction both in terms of numbers of distinct networks and in terms of central data processing sites, shows very clearly in the study.

  - While the selection of an appropriate solution is still open to considerable debate (SNA versus distributed versus packet, etc.),users' desire to reduce the absolute number of networks, as well as their redundancy, is very strong.

- With the exception of the very decentralized organizations, particularly those in the diversified financial industry, most of the companies studied either are

implementing some form of integrated data network or are in the process of studying such a possibility.

- The integration of message networks with data networks is more a matter of direct conversion from one to the other.

- The external message networks for intercompany and international applications have, in a few companies, become special Telex or TWX ports on the data network, and the messages are prepared as a part of the data systems and forwarded to the appropriate external service.

- The integration of facsimile networks with data networks was mentioned by a few respondents as being desirable, usually in the context of an OCR interface or, more commonly, using facsimile as a receive-only terminal from a data system.

- Among the many companies in which office automation task forces are in operation, a position trend is becoming apparent. It is the systems or data processing organization which seems to be coming out with the responsibility for the implementation of office automation functions.

  - Given that this is the case, the long-term expectation is that electronic mail will indeed become a subset of the data networks, but with special I/O equipment and with some amount of special software and data base management tools.

- In the long term, the integration of voice and data possesses by far the largest potential for major economic and functional improvements. The overall integration of voice and data is very certainly a long way off in the future, but it is even more certainly coming.

- This future voice/data integration will not simply happen. It will evolve. It will grow from a number of different sources or points of integration.

- Many of these points of integration are already visible, as in the use of the companies' voice networks for implementing some parts of data networks and the growing digitization of the voice network itself.

- One of the key points of integration between voice and data is that of organization. At the present time relatively few of the large organizations have a single individual responsible for both voice and data communications.

  - While it is true that in many organizations the voice communication manager and the data communication manager ultimately report to the same senior information executive, the network integration will not occur at that level.

  - It will occur at the level of a working communication manager responsible for both voice and data networks.

  - It will occur in organizations where this responsibility is not only centralized but unified in a single, technically qualified individual.

VI EVALUATION OF NEW NETWORK ALTERNATIVES

VI EVALUATION OF NEW NETWORK ALTERNATIVES

A. TECHNOLOGY AS THE DRIVING FORCE

- One of the driving forces leading users to consider new kinds of solutions and methods of approaching their communication requirements is technology.

- Technology is presented to the communication personnel in user organizations in a number of ways.

  - One of those ways obviously is the communication manager educating himself as to new product offerings from the vendors.

  - Another way is the vendors' advertising, writing articles in various trade journals and sending salespeople to make presentations to their potential customers.

  - Of increasing significance in the array of methods of communications of technology to the users' communication professionals, is the presentation of technology in the lay press to various persons in the management of user organizations. Publications such as Fortune, Time and The New York Times, as well as the more business-oriented periodicals such as Business Week and The Wall Street Journal, have

frequent and, in some cases, regular articles on the subject of technology. Information technology (in particular, communication technology) is among the hottest editorial items in the lay press currently.

B. TRENDS IN THE VOICE NETWORK MARKETPLACE

- There are six basic network elements from which the voice network marketplace is developed. These are shown in Exhibit VI-1.

1. LD TRANSMISSION

- Long-distance transmission represents the largest single identifiable cost in a voice network; however, in total it is usually in the 25% to 35% overall cost of such a network.

- While there are a number of technologies affecting this element of networks, such as Satellite Transmission and Fiber Optics, the primary trend that is visible is that of pricing.

    - Pricing in the communications industry, long a stable structure, is now becoming a dynamic, competitive structure. Essentially what this means is that where competition is present, prices have declined and where it is not, prices have increased.

    - This does not necessarily mean it has become a "whatever the customer will bear" situation but rather that competition has been focused on the high demand marketplaces such as New York to Chicago, New York to Washington, etc. The common carrier response to these new sources of competition is the development of the route-based pricing structure, MPL (multischedule private line).

EXHIBIT VI-1

VOICE NETWORK MARKET
TRENDS

NETWORK ELEMENTS	PRODUCT/SERVICE TRENDS	COMPETITIVE TRENDS	LONG-RANGE EXPECTATIONS
LD TRANSMISSION	COMPETITIVE PRICING	LARGE COMPETITORS ONLY	DEMAND LEVEL PRICING
NETWORK SWITCHING	INCREASED NETWORK CONTROL	INDEPENDENTS GAINING	CONTROLLED SYSTEMS
LOCAL TRANSMISSION	SOLUTION EXPERIMENTS	CATV? ROOFTOP ANTENNAE? RADIO?	CONTINUING BOTTLENECK
PBX	INCREASED FUNCTIONAL CAPABILITY	INDEPENDENTS GAINING	SERVICES DISTRIBUTION POINT
INSIDE WIRING	NEW TECHNOLOGY	DEREGULATED	BATTLEGROUND FOR CARRIERS/PBX/ EQUIPMENT MANUFACTURERS
TELEPHONE INSTRUMENTS	NEW TECHNOLOGY	SUPPLIED BY PBX VENDOR	PRIMARY EMPLOYEE INTERFACE

- A new element of competition coming into this marketplace, the satellite carriers (primarily SBS) can expect to elicit another type of competitive response from AT&T. These new carriers, selling high bandwidth services, can also expect to see competitive products and pricing from AT&T.

  - Currently the AT&T bulk service, Telpak, has been declared illegal and is scheduled to be withdrawn December 21, 1980. Even if this occurs on schedule. It is unlikely that Bell, the primary long-distance carrier, will be without a bulk tariff of some sort for long.

- The competitors in the long-distance transmission market are narrowing to a relatively few very large companies. It would not be surprising to see many of the survivors be acquired in the near future. The long-distance transmission field would then be left to the very large carriers.

- In the long range the industry can expect to see a continuation of the competitive pricing policies of these large companies. The end effect of this competition is that pricing will be oriented around the level of demand that can be sustained. Large users and large market areas will have relatively low-priced transmission capabilities available to them whereas the smaller and more remote users will have to pay a higher price for transmission capabilities.

  - One of the by-products of deregulation is that economic scale factor is becoming a very real element of the supply and demand curve, which in turn dictates pricing. An excellent example of the results of such deregulation can be seen in the current situation in airline fares and services.

2. NETWORK SWITCHING

- Switching is essentially a tool whereby users can share the cost of transmission facilities that are only required for part of the time. It is in some of the areas of network switching where technology has made its greatest impact on

communication costs. Intelligent routing and operator/labor cost reduction have been the primary examples of such impact:

- A key current trend in network switching products is the increased level of control of the network which new switching technology has provided to the network operator. This increased control is available to both the public network operators such as AT&T as well as the private network operators. This improved network control manifests itself in forms such as the availability of detailed traffic data for later analysis and network optimization, and the availability of transmission test routines and of rerouting and network reconfiguration processes.

- Generally these new capabilities have become available sooner and more powerfully through the independent switch manufacturers than they have through AT&T. Although private network switching capability has always been available from Bell and the other carriers, it is only recently available from independent switch manufacturers. However, these independent switch manufacturers have been gaining ground very rapidly on the common carriers in the provision of network switching capabilities to large users.

- The long-range expectations for network switching are that the users will have available a very tightly controlled voice network system in addition to some of the tests, analysis and intelligent routing functions mentioned previously. For example, instead of having the network provide a uniform grade of service for all possible users, the advanced network switching systems will be able to provide a good grade of service for executives and other high-cost operations, and a lower grade of service for lower-cost or deferrable kinds of operations.

3. LOCAL TRANSMISSION

- Transmission facilities between the users' premises and the nearest common carrier switching or long-distance/transmission facility is the network element with the smallest set of available alternatives. It is today provided by copper wire.

- While new technology such as T Carrier and other techniques have been applied to this problem, the scale factor is so small relative to the long distance transmission facilities that the implementation becomes a vast logistic and economic problem.

- The visible trends among this element of the network are not very promising. A number of organizations, recognizing the problem, are experimenting with solutions, which may represent practical solutions for the problem in the future.

- The competition to address this portion of the market is still in the questionable stage.

  - The most obvious source of competition is the CATV providers. Yet these companies have for the most part avoided the extensive changes in their own networks that would be required to serve this two-way communication requirement.

  - One key exception to this is Manhattan Cable in New York City, which is installing capability and providing services for interconnection within the island of Manhattan.

- Another alternative, which has been used by a number of companies, is digital microwave. This is for specific companies and is a relatively expensive solution that can only be supported by relatively high-volume, interbuilding requirements.

  - A good example of this is the six-station network implemented by Prime in the Boston area. Digital radio is the solution proposed by XTEN, the Xerox venture into the domestic specialized carrier business.

- Broadcast radio at microwave frequencies is another possible alternative. The Multipoint Data Service, now primarily a one-way service, is being examined by the FCC as an alternative.

- No clear long-range solution to this problem is yet obvious, and local transmission is expected to be a continuing bottleneck through 1990.

- The publicity on local trasmission has been heavily on the data application requirements. However, even if the end solution is the same technology, the voice applications will pay the bills.

4. PBX

- The PBX, or PABX, as the independent providers prefer to term it, is the on-site switching system which interconnects users within a premise and also connects them to the long-distance transmission facility. It is the PBX element of the marketplace that first gave extensive competition to the common carriers. Originally this competition was strictly price competition.

- More recently, technology has allowed the PBX products to develop an increased level of functional capability. PBXs are now largely sold on these features. Many of the features wind up being almost completely unused, but it remains a useful selling tool for the companies manufacturing PBXs.

- As in the network-switching area, the independent PBX manufacturers are gaining significant ground on the common carriers. The features and a lower price and a much stronger sales effort are giving the independent companies an increasingly larger share of the market. The carriers have, of course, responded with new PBX products of their own, but the products of independents continue to stay a step ahead in terms of available features. A good example of this is the data compatability features offered by ROLM, Northern Telecom and InteCom.

- In the future, the expectations for PBX are that it will become, for a given building, a point from which a variety of services are distributed. In addition to simply being a control point for voice communications services, the PBX will provide the distribution and control and possibly even the data base management functions of other services such as message, electronic mail and low-speed data.

5. INSIDE WIRING

- The connection between the PBX and a telephone instrument is also today a pair of copper wires. Until the onset of competition from independent PBX suppliers all of this inside wiring was, and most of it still is, provided by a common carrier.

- Inside wiring is beginning to receive significant attention. Most of the technology attention is oriented toward wide band inside wiring for data applications. However, it is beginning to be recognized by these new technology providers that the voice network represents the high-volume application which can support an extensive installation cost. This new technology, most of which centers around the use of shared, wide-band transmission lines has in the last few months addressed some major questions about its application for voice services. The Ethernet, originated and primarily promoted by Xerox, has just recently been introduced to the marketplace in the form of a highly available spec.

- The primary supplier of inside wiring remains AT&T. Inside wiring is one of the key items that is likely to become a focal point for significant argument during the deregulation process which is currently creating a number of headlines.

  - One of the specific items which was addressed in Computer Inquiry II is the status of regulation related to inside wiring. The FCC stated that this would not be required to be deregulated.

- AT&T, on the other hand, has suggested that the appropriate place to differentiate regulated from unregulated is at the protector block, which is found at the communication entrance to a building. This would then say that all inside wiring would be unregulated and therefore presumably the property of Bell's new unregulated subsidiary.

- If the Bell position is allowed to stand, this could provide Bell with a very significant advantage in the provision of unregulated equipment within those buildings already wired by Bell.

- In the long term, the ownership and the type of inside wiring is likely to be a battleground among the common carriers, the PBX manufacturers and the manufacturers of other equipment, which requires the use of inside wiring. Even now these battles are beginning to shape up in the FCC and in the standards committees.

    - The long-range expectation is that the results of these battles will be some form of compromise whereby the PBX continues as a point from which various services are distributed but the transmission between the PBX and the local instrument is carried over a wide-band channel and some of the switching functions are themselves distributed into logic that becomes a part of that wide-band channel as in some versions of today's Ethernet.

    - It is likely, however, that this resolution will occupy most of the decade.

6. TELEPHONE INSTRUMENTS

- The basic telephone instrument, which has remained unchanged for nearly a hundred years (except for the plastic cover and the touch-tone pad), is only now being impacted by new, solid-state technology.

- The telephone is being impacted by new technology in terms of cost reduction, new user enhancement features, and new system interfaces.

  - The cost reduction comes about by the conversion of electrical and electromechanical components into solid state chips. For example, the hybrid coil, a transformer-like device which converts the four-wire telephone operation into a two-wire operation for use on two-wire local loops, has been reduced to a chip, which is likely to be introduced into a telephone set in the near future.

  - The new user features include small displays which can inform the user of such things as the caller identification, scheduled call reminders, etc. It also includes single function buttons rather than the control of the instrument through procedures such as switch hook flashing or special touch-tone code sequences.

  - The system features include the PCM encoding of the voice signal for ease of later transmission, and also the encoding of special instructions such as conference calling or speed calling.

- In terms of competition, the telephone instrument is usually provided by the PBX provider. Obviously this is true for those instruments which are attached to a PBX system; however, it is also true to a large extent for single-station and keystation telephone instruments (which comprise about half of the business telephone market).

  - Again, as in the case of PBXs, much of the new technology has been brought to the telephone instrument by the independent manufacturers Usually the same companies that make the PBXs.

- In the long run the telephone instrument is likely to become a more powerful human interface providing additional functions over and above basic voice communications to the employee at the telephone-equipped workstation.

- Already seen is the addition of data compatability with the telephone instrument in a number of different forms. Additional services, provided on a system basis with the functions shared between the human-engineered telephone instrument and the PBX acting as a services distribution point are likely to further enhance the utility of the telephone instrument.

- Rather than voice communication functions being replaced by keyboard communications, technology is likely to place voice communications in general, and the telephone instrument in particular, into a position as the primary information tool for most employees in large organizations.

C. VOICE NETWORK ALTERNATIVES

- The voice market represents by far the majority of user expenditures for communication products and services.

- Until recent years, voice communications have been primarily the domain of the telephone companies. New regulatory policies at the federal level have brought numerous new competitors into this field, which are in turn bringing new technology to bear on voice applications at a rate faster than Bell had introduced such technology in the past.

- The application of this new technology, usually digital technology, to the voice market has brought with it significant new attention on the part of the users in examining new kinds of alternatives for their voice networks.

1. VOICE DIGITIZING

- The potential value of the application of digital processing techniques to voice applications comes out very clearly in both the user and vendor interviews conducted for this study.

- The use of digital techniques in the telephone carrier plant is not a new process. The use of T carrier for interoffice trunk requirements in the Bell System has been going on since the early 1960s. There are today some one hundred million voice circuit miles of T carrier implemented within the Bell plant.

- This does not mean that this digital voice capability is available or even visible to the end user of such facilities. Digitized voice, even at 100 million miles, represents a relatively small fraction of the approximately two billion miles of voice circuits implemented within the Bell plant.

  - Digital carrier today addresses a very specific and relatively narrow requirement which is the medium-distance, high-volume trunks between Bell switching offices.

  - Digital carrier is not applied to the very large, long-distance facilities, which are still more efficient when operated with analog multiplexing techniques.

  - Similarly, digital carrier is not yet used to any great extent in the local loop plant which connects subscribers to the Bell serving central office. However, this local loop plant is, in fact, highly susceptible to the application of digital carrier techniques and Bell is now extending its application of T carrier to this one billion mile facility.

- Other applications of digitization of voice are in the form of new products which specifically digitize single voice circuits for transmission over standard data transmission channels.

  - An example of such a product is the voice digitizer developed by Time and Space Processing and introduced by CODEX earlier this year. This unit uses linear predictive coding to convert standard voice into a 2,400 byte per seconds transmission path.

- A pair of such units costs approximately $25,000 dollars and is therefore today only applicable on relatively long-distance circuits.

- However, this technology of digitizing voice at low data rates which can more economically be transmitted over the long-distance facilities is almost certain to receive much more attention in the near future. New vocoder techniques, which are relatively expensive today, will be able to perform this voice digitizing at the 2,400 bit per second level and perhaps even lower, at prices which are likely to be comparable to the $3,000 price range now applicable to voice grade modems.

  - New voice coding and synthesis techniques, aided in large part by the huge "talking games" marketplace (such as Texas Instrument "Speak And Spell"), are likely to be the guiding forces in bringing this technology to the communication field.

2. VOICE MULTIPLEXING

- On overseas voice circuits, which cost in the range of $10,000 a month and up today, techniques for gaining better utilization of groups of trunks have been applicable for many decades. Specifically TASI (Time Assigned Speech Interpolation) has been used for many years by the Bell system. This technique, however, is only applicable to large groups of trunks.

- New implementations of this technique using more modern technology have been introduced recently by some vendors. Specifically, the COM-2 from Storage Technology Communications Corporation is a TASI type of technology but is applicable to trunk groups down to nine circuits. COM-2, like the Bell TASI, achieves trunk reductions on the order of a factor of two by means of taking advantage of the inherently half duplex nature of voice telephone conversations.

- In the reasonably near future (by 1985) users can expect to see combinations of intelligent multiplexing, voice digitizing and TASI-type multiplexing being

available on a wide scale. One of the driving forces in the direction of such technology is the expected large increases in Bell private line rates expected in the near future.

3. VOICE STORE AND FORWARD

- At present, voice store and forward is in the nature of experiments being conducted by users. It is a category of new applications which will require significant market development and user education in order to achieve any significant level of market penetration. Experimental products from Electronic Communications Systems in Dallas are being tested by some major users. The experimental users regard the product and its capabilities as too premature to draw significant conclusions; however, they do anticipate significant advantages in the form of implementation of electronic mail types of services through the use of these presumably more human-convenient voice entry and delivery techniques.

- A California company, Televoice, Inc., is offering store and forward message services on a service basis from its operations in Sunnyvale, CA.

- AT&T has an extensive experiment being placed into service in a residential area of Philadelphia. This system, built around ESS technology with the addition of a large bulk storage capability (the #1 VSS), has been delayed in its service introduction for six months by the Pennsylvania Public Utility Commission. The basis of the delay was a set of complaints from message service providers who regard this voice storage service from Bell as an enhanced service in accordance with the terms of the Computer Inquiry II decision. The Pennsylvania Public Utility Commission is taking the time to examine this question, and the tariff has been deferred until January 1981.

4. THE BASIC TELEPHONE NETWORK

- In addition to these accessory kinds of offerings some major enhancements to the control systems of the long-distance message telephone service have

potentially even greater long-term significance to both voice and data transmission users.

- The CCIS (Common Control Interoffice Signaling) is a capability whereby the control information with which calls are routed is transmitted on an entirely separate network from the basic voice transmission network. In the past, control signals such as dial pulses or tones, busy signals, etc., were transmitted in advance of a call down the same transmission paths that would ultimately be used for the call itself.

- This separate data network called CCIS, which is inherently more capable of handling this control type of information, is being rapidly deployed by AT&T.

• In addition to removing the control signals from the voice transmission network and thereby gaining an approximate 10% increase in basic transmission capability, this new system provides a number of inherently new types of capabilities.

  - First of all, it will enable calls to be completed in a much faster time than the existing methods. A long-distance completion today averages in the order of 20 seconds from the end of dialing to the beginning of destination station ringing. Call completion times with the new CCIS in operation are anticipated to be down in the two to three second range.

  - A second and much broader set of capabilities is that provided by means of the availability of a central data base of subscriber numbers and routing signals. Through the use of this central data base, destination numbers can be translated from those entered by the calling station to other numbers. Number changes, call forwarding services for busy stations, alternate routing or other such services remain simply to be imagined by users.

- One such example discussed extensively by Bell is the possibility of converting 800 type national numbers into the appropriate local number depending upon the location of the orginating caller.

- For example, a single 800 number used by the Automobile Association of America could be translated into the specific number of the AAA garage nearest to the origination rather than go to a central telephone bureau and then be forwarded back to that same garage.

- Other kinds of number translation capabilities (some of which are already available to certain ESS exchange subscribers) include speed calling or abbreviated number calling, call queuing, etc.

- Users can anticipate that the increasingly intelligent Bell voice network will be providing many of these capabilities to subscribers as soon as the ESS ability is in place and as fast as the regulatory processes allow Bell to participate in such operations.

D. TRENDS IN THE DATA NETWORK MARKETPLACE

- There are seven basic network elements which can be defined for the data network marketplace. These are shown in Exhibit VI-2. Most of these elements are analogous to the elements of the voice networks in Exhibit VI-1, and in some cases they are identical.

1. COMPUTER/FRONT ENDS

- While some companies are just reaching the point of implementing first-generation on-line systems, other companies have reached the point of implementing third-generation data networks, some of which are host-independent.

EXHIBIT VI-2

DATA NETWORK MARKET TRENDS

NETWORK ELEMENT	PRODUCT/ SERVICE TRENDS	COMPETITIVE TRENDS	LONG-RANGE EXPECTATIONS
COMPUTER/FRONT END	HOST-DRIVEN VERSUS INDEPENDENT NETWORKS	CONCEPT COMPETITION	INDEPENDENT OF NETWORK
LONG-DISTANCE TRANSMISSION	INCREASING BANDWIDTH	LARGE COMPETITORS ONLY	INTEGRATED WITH VOICE
DATA SWITCHING	NETWORK CONTROL SYSTEMS	MINICOMPUTERS GAINING	DISTRIBUTED CONTROL
LOCAL TRANSMISSION	SOLUTION EXPERIMENTS	CATV? ROOF-TOP ANTENNAE? RADIO?	CONTINUING BOTTLENECK
MODEMS	PERFORMING TESTS	EQUIPMENT VERSUS SYSTEMS	- PART OF CONTROL SYSTEM - DIGITAL SERVICE UNITS
INSIDE WIRING	NEW TECHNOLOGY	DEREGULATED	COMBINED PBX/ WIDEBAND
TERMINALS OPERATOR MEDIA TRANSACTION	SIMPLE, HIGH-GROWTH INTELLIGENT MULTIFUNCTION	PRICE DELIVERY SYSTEM MANUFACTURERS INDUSTRY MARKETING	NEW TECHNOLOGY LOCAL PROCESSORS MULTIFUNCTION

- This competition of concepts will probably extend for most of the decade, with the large mainframe companies led by IBM expanding the implementation of the host-driven systems in the beginning of the decade, and the minicomputer companies implementing independent networks gaining market position later.

2. LONG-DISTANCE TRANSMISSION

- The market situation here is almost identical to that in the voice market except that there are more technical alternatives available in the data network market.

- Increasing bandwidth will become an important product capability, especially for large locations in the Fortune 500/50 market.

3. DATA SWITCHING

- In this category are included all of the sharing and cost-reducing elements of the network. This includes:

  - Concentrators.

  - Multiplexers.

  - Message switchers.

  - Packet switches, etc.

- This is where the actual control of the network is placed in the independent network concept.

- The minicomputer manufacturers and the other intelligent network hardware manufacturers will be competing for position and for market share against the mainframe manufacturers.

- In the long run, the control of the network will be distributed, with coordination, to multiple locations much like the human nervous system.

4. LOCAL TRANSMISSION

- The situation is identical to that of the voice network marketplace.

5. MODEMS

- Today modems are the interfaces to the analog voice network. In addition to their transmission function, modems are beginning to be used as the local test instrument to perform network monitoring functions for the central control system.

- Competition today is in the mode of selling equipment but is rapidly converting to a system-selling mode.

- Modems will ultimately become an integral part of the network control system.

- While continuing to perform their network-to-device interface role, modems will not be required to perform the digital/analog function on the digital transmission circuits, which will be much more prevalent in the next few years.

  - Modems in a rigorous definitional sense will give way to a digital line interface device, or DSU (Digital Service Unit).

6. INSIDE WIRING

- Again, the situation is identical to that in the voice marketplace.

7. TERMINALS

- Operator terminal requirements are still in the direction of simple devices with a high growth of installations.

- Competition is now in a commodity-like price war.

- Ultimately new display and printing technology will produce some significant changes in this operator terminal market.

- The media or batch terminal market is rapidly becoming a local processor-type market, dominated by the system manufacturers.

- The transaction terminal market is becoming an industry-oriented market with multiple functions required to be performed at each device.

E. DATA NETWORK ALTERNATIVES

1. SNA (SYSTEMS NETWORK ARCHITECTURE)

- SNA was developed by IBM and introduced in 1974. It has had a number of significant improvements since its initial introduction.

- The rationale for the development of SNA, according to the more or less official version, is that prior to SNA communications problems were being tackled on an *ad hoc* basis, resulting in:

  - Some 200 different products relating to communications.

  - Some 35 different teleprocessing access methods.

  - Some 15 different data link controls.

- The initial introduction of SNA included the following specific products:

  - VTAM as the teleprocessing access method in the single-host CPU.

  - 370X communication processor to off-load line management details from the CPU.

  - NCP as the operating system for the 370X.

  - SDLC (Synchronous Data Link Control) as the link control discipline with a line of terminals and cluster controllers including the 3767, the 3770, the 3600 Industry Terminals and later the 3790 and 3270 SDLC-compatible versions of the 3790 and 3270 families.

- As evidenced by Exhibit VI-3, the conversion rate of large users to SNA is clearly growing. The reasons for this acceptance growth are:

  - The cost of the required extended amount of memory has come down dramatically since the initial introduction of SNA.

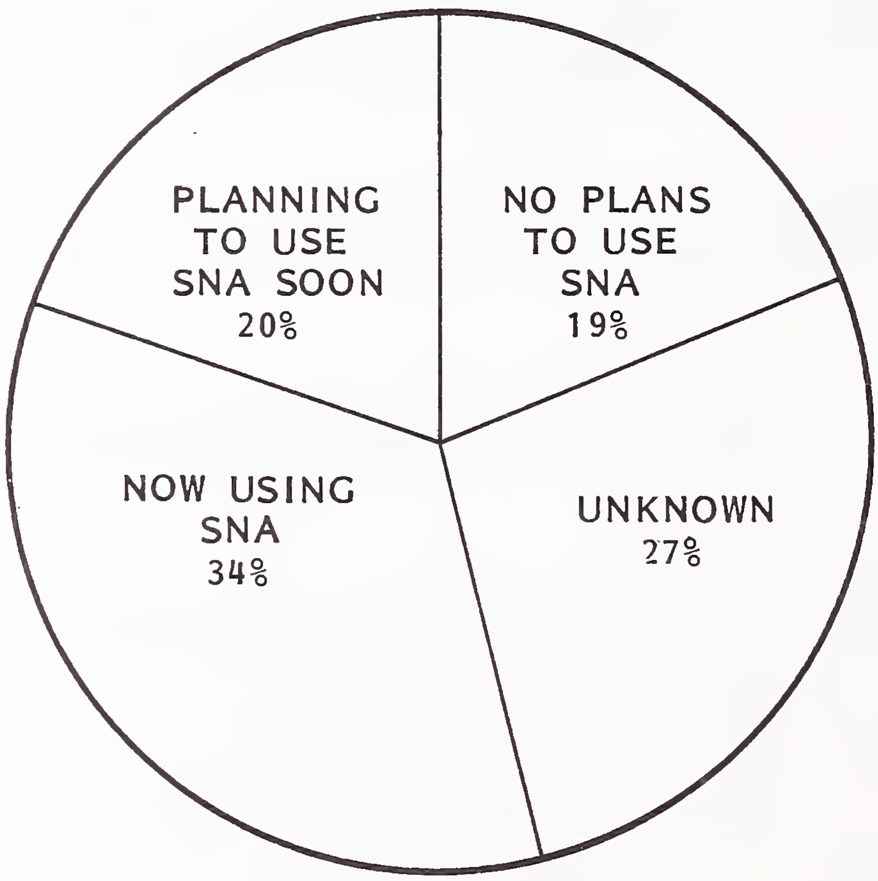
  - IBM backed down from its initial inflexible position and now permits ASCII Terminals (including IBM's own recent 3101) and the popular TCAM software within the SNA framework.

  - More powerful features including multisystem network facilities allowing the operation of multiple hosts, network management and control capabilities (NCCF and NPDA), support of multiple interhost links and alternate routing algorithms.

- IBM continues to exert pressure on users to move deeper into SNA by making more software products depend on SNA and dropping support for previous non-SNA dependent versions.

EXHIBIT VI-3

PENETRATION OF SNA AMONG
FORTUNE 500/50 COMPANIES WITH ONLY IBM HOSTS



- Many more products are now supporting SNA, including especially the 4300s and the 8100s allowing for the first time an effective DDP network consisting entirely of IBM-DPD supplied products.

- In addition, new intelligent modems and a variety of competitively priced SNA-compatible terminals have been introduced providing IBM with a very complete product line of SNA-compatible hardware and software.

- A fundamental concept in SNA, and indeed in several other of the better-defined network architectures, especially the OSI Reference Model (OSI, Open System Interconnection) is that of separating the functions involved in commmunications between end users into several distinct layers and sublayers. The primary objectives of this separation are:

  - To make each layer self-contained so that changes to it will not require comparable changes in other layers.

  - To make the inner layers transparent to outer layers.

- While many of the original criticisms of SNA have been answered by improvements made over the last five years, a number of criticisms remain. SNA is inherently a host-oriented architecture. Many of the protocol layers are implemented within the host access method (this includes presentation, transmission and data flow control).

  - SNA is not particularly well suited for what appears to be a trend toward the ultimate merging of data, voice and other networks, especially when compared to the OSI architecture.

  - There continues to be a question as to just how closely or conveniently IBM will address the standard. IBM has in the last year demonstrated a significant recognition of the existence of X.25 and in fact supports X.25 and its physical interface level, X.21, in other countries. The manner in which X.25 is supported by SNA is by wrapping the standard

SNA block inside of an X.25 packet, thus essentially duplicating the packet headers and adding further communications overhead.

- IBM's solution is essentially that of a "gateway box." This box "5973" along with a software PRPQ in the 370X forms the SNA to X.25 protocol conversions.

2. LOCAL DATA NETWORKS

- While many data terminals are distributed to locations remote from the host computer site, a large percentage of terminals remain in the same building. Many of these remaining data terminals have been distributed around the building to various operating organizations so that access to the host computer can be accomplished conveniently.

- In addition to these data terminals, there is a growing array of other kinds of processing equipment located in functional departments which also needs occasional or frequent connection to the large mainframe.

    - These other devices are usually minicomputers of various types and sizes but may also include other more specialized types of equipment such as laboratory instrumentation systems, process control systems and also energy and security management systems.

- The communication connection between these terminals and other information systems and the large mainframe center has had two alternatives in the past: the installed voice system (that is the PBX/Network), and separate dedicated wires installed specifically for that device.

    - Neither of these solutions is completely satisfactory. The dedicated line is a very expensive solution and the use of the PBX places not only speed and sometimes noise limitations on the terminal operation, but also adversely impacts the performance of the PBX system itself due to the long holding times often involved.

- A number of shared, wide-band circuit solutions have been developed over the last few years to address this problem. None of these has yet captured any significant fraction of the marketplace.

  - Most of the solutions share a coax cable or in a few cases are proposing the use of fiber optic cable.

  - A few use twisted pair which, over the short distances involved within a building, can carry a significant bandwidth.

  - In all cases the data are carried on the channel serially rather than in parallel.

- One such twisted pair based system is that provided by TELCOM, Inc., of Phoenix, Arizona. In this case a 32 channel time division multiplex system can allow 32 separate channels each operating at up to 2,400 bits per second to be distributed around a building.

  - In the current system any one of those thirty-two channels can be manually selected by a terminal operator.

  - The channel is selected by turning a thumb wheel and its availability is indicated by the absence of a busy light for the particular channel.

  - An updated version of this system will operate the same thirty-two channels at up to 9,600 bits per second.

  - Channels can be combined to obtain 19.2 KBS or higher speeds. This newer version will automatically select an unoccupied channel if available.

  - The station controller in this system will cost about $600 per channel. The loop controller will cost $2,500 and up depending on the number of channels implemented.

- Installation cost for this system will vary widely, as it will in most systems, but would run typically in the $150-per-station range, approximately the price of a PBX station installation.

- Among the coax cable-based systems, the multiplex system with the most experience at this time is that provided by AMDAX (previously called American Modem Company). This system, which is installed in a number of manufacturing plants, operates using CATV kinds of components and places radio frequency modems at each of the drops.

  - As presently designed, this system is capable of handling up to 56 stations on a single CATV channel, with each station capable of carrying up to 19.2 KBPS of data.

  - One of the advantages of this kind of system is that the single coaxial cable can also carry on another TV channel other kinds of signals such as video for security monitoring and also voice with the proper type of carrier equipment.

  - Again the installation cost is likely to be one of the most significant elements of cost in the system, representing up to one-third of the total cost. Proponents of coax claim that the actual installation cost of coax is, or at least could be, less than that of twisted pair because of the need to place twisted pair in a duct or conduit which might not otherwise be available to the installer. The conduit in most existing buildings is dedicated to either power lines or the telephone company.

- The other approach to the implementation of local data networks is that of time division or switching of the line. Again the line is usually a coax cable, but at this point in time there are dozens of different approaches to the manner in which the cable is to be timeshared.

  - Most of the alternatives use some variant of packet-switching techniques.

- Ethernet is probably the best-known system for local data networks. It is a concept basically developed at the Xerox research center. Specifications for the Ethernet standard were released by a consortium of Xerox, Intel and Digital Equipment Corporation as of the first of October, 1980.

- Ethernet, as defined by these standards, is a base band coax cable system operating at 10 megabits per second. Interfaces to this network, basically the subject of the specifications released, are expected to be implemented in products designed to those specifications. Xerox itself has introduced two products in the last year which interface to the Ethernet system. One of these is the model 860 word processing system and, more recently, the model 5700 high-speed lazer printer system.

- Intel is expected to produce chip sets which can be implemented into any manufacturer's hardware to provide an interface to the Ethernet system. DEC is expected to produce high-level architecture products through which large data processing systems can be interfaced into the same Ethernet system.

- Xerox, according to the specification, is intending to provide the basic maintenance of the specification and of users attached to the system. IT is providing a license to use the Ethernet specification at a fixed price of $1,000 for unlimited use. It is also providing a central clearing house for assigning addresses within the 48-bit address structure of the specification.

    - This 48-bit structure is presumably adequate to allow all possible future devices to be attachable to the Ethernet system with a unique, world-wide address.

- Some of the Ethernet architects have been examining the use of Ethernet for voice applications. One of the assumptions made is that the speed increase from the originally announced 3-megabit-per-second rate to the specified 10-megabit-per-second rate is to provide a capability which would allow voice communications to be handled over the Ethernet system.

- Since voice is by far the largest user of transmission capacity and also the largest payer of communication bills, a broadly conceived system which could not handle voice would tend to be very limiting in its application for users.

• In some systems the cable is divided both by frequency division and by time or packet division.

  - The system provided by Sytek of Sunnyvale, California, is such a system. The basic coaxial cable band width is subdivided into some number of channels. In one version the system is divided into 120 channels, each of 128 KBS band width.

  - In another version the cable is divided into five channels of 2 megabit per second band width. Each of the channels, either 128 KBS or 2 MBS, is treated as a separate packet network.

  - An interface unit called a packet communication unit, which consists of a radio frequency modem and a packet controller, interfaces with the channel in much the same method as the Ethernet control system.

  - The sending and receiving operations on the channel are controlled by a radio frequency head end operation much like that of a cable TV system.

  - The cost of a Sytek system is also in the range of $500 per interface (packet communication unit).

  - Sytek is planning to introduce in conjunction with this network many value added capabilities which can be joined with the CPU to provide more powerful services. These include, for example, a speed conversion process whereby 1,200 band units may be able to communicate with 9,600 bit per second units.

- Also included will be encryption devices which may be necessary on shared cable and a symbolic addressing capability wherein the user may enter a Mnemonic address which the packet communication unit will convert into the appropriate network address.

3. NETWORK MANAGEMENT CONTROL EQUIPMENT

- As advanced network control equipment becomes available, most of the users in the sample are implementing this equipment to some degree.

- The degree as noted previously is largely a function of their size but also of their level of reliance on major vendors. Of this kind of equipment can be distinguished two major categories:

  - Data network control systems.

  - Voice network data recording systems.

- Data network control systems. The simplest of these systems are the technical control centers implemented with a limited number of test instruments. The more sophisticated systems are integrated monitoring and test networks up to and including networks implemented directly into the data communication central nodes themselves. In all cases, there is an attempt to bring the control of networks into a single or at least a limited number of centers.

- Tech control centers. The simplest of these kinds of centers includes a limited array of instruments.

  - The primary instrument is a line content monitor. There is a device produced by Spectron called a Data Scope and some comparable units produced by Halcyon, Atlantic Research, etc.

- Other equipment in a typical test center would include analog line testers, EIA monitors and bit error rate testers. In some of the more sophisticated tech control centers, these instruments are connected through a patch panel or, in some cases, a remote control switch panel such that the instruments can be applied to any of the lines or devices suspected to be in difficulty.

- Generally, monitoring from these locations is done at off hours because monitoring with these kinds of equipments usually involves interrupting the signal path to perform the necessary tests.

• Network control systems. At the next level of sophistication, there are a series of products, generally introduced by the modem manufacturers, which have the ability not only to test the lines and modems but also, more importantly, to continuously monitor the performance of the modems and thus the entire network.

  - There are a number of competing concepts for the performance of this function. These concepts are listed in Exhibit VI-4.

• One concept uses a separate unit of diagnostic hardware which electrically surrounds each modem; that is, it bridges into all of the modem connections on the analog as well as on the digital side.

  - Information gathered from these connections is transmitted back through a low-speed secondary channel on the same circuit to the central control unit.

  - The central control unit continuously polls each of these diagnostic units to determine the performance of the network at each point.

EXHIBIT VI-4

NETWORK CONTROL SYSTEM CONCEPTS

METHODS OF TEST CONNECTION

- HELPING HANDS AT TEST SITE
- REMOTE CONTROLLED LOOPBACK
- WRAPAROUND TEST EQUIPMENT
- BUILT-IN DIAGNOSTIC PROCESSOR

TRANSMISSION OF TEST RESULTS

- VOICE COORDINATION
- INDEPENDENT DIAL-UP NETWORK
- SECONDARY CHANNEL
- PRIMARY CHANNEL WITH INTERRUPTION
- PRIMARY CHANNEL IN DATA STREAM

- If the monitoring system indicates a need for diagnostic testing, the test is controlled from that diagnostic box attached to the modem. One of the major advantages of this approach is that the system can be applied to any type of modem from any manufacturer.

- General Datacom is one of the manufacturers of this kind of a system.

• A more common approach is that taken by a number of the other modem manufacturers such as CODEX, Intertel, Racal/Milgo, etc. In this approach a diagnostic microprocessor is built into each of the company's modems. The monitoring and, if necessary, diagnostic testing are performed, again using the secondary channel of the basic transmission path.

  - AT&T is in the process of introducing such a system of modems and network control centers known as the Dataphone II.

• The third approach to a network control system is that being provided by IBM. In this system the host of a network incorporates both network control and monitoring capability along with the regular SNA communication control system.

  - This system transmits and receives the monitoring and diagnostic commands and the resulting data as regular data on the communication line.

  - The modems are again equipped with diagnostic microprocessors.

• A higher level of control is that of network management. The concepts and trends in network management are shown in Exhibits VI-5 and VI-6.

EXHIBIT VI-5

LEVELS OF NETWORK MANAGEMENT FACILITIES

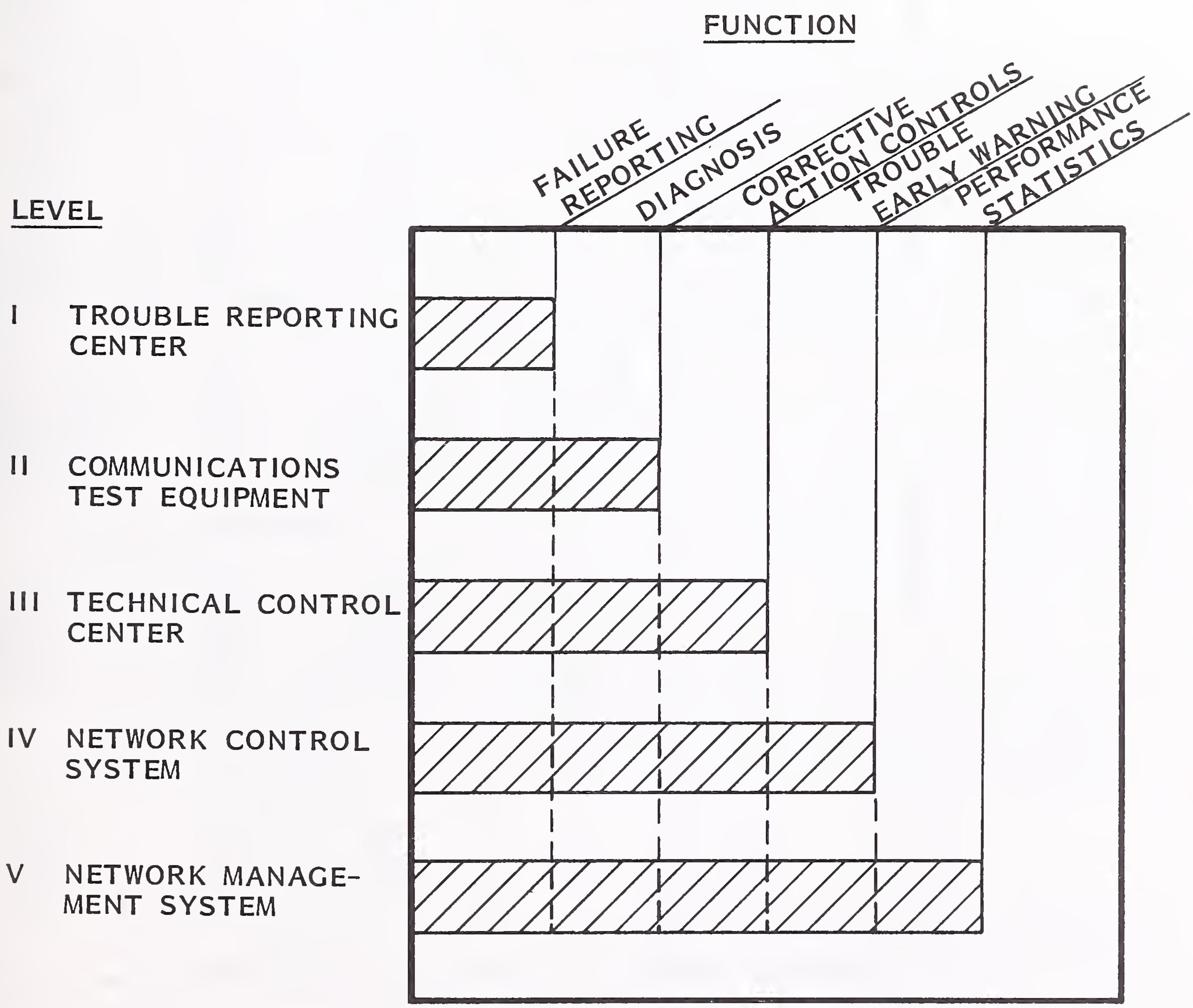


EXHIBIT VI-6

TRENDS IN NETWORK MANAGEMENT TECHNIQUES

NETWORK	TIME FRAME	FUNCTION				
		FAILURE REPORTING	DIAGNOSIS	CORRECTIVE ACTION CONTROLS	TROUBLE EARLY WARNING	PERFORMANCE STATISTICS
DATA NETWORKS	NOW	DATA PROCESSING CENTER OPERATOR	COMMUNI-CATION TEST EQUIPMENT	VENDOR	NONE	NONE
	NEAR FUTURE	NETWORK CONTROL SYSTEM	NETWORK CONTROL SYSTEM	NETWORK CONTROL SYSTEM	NETWORK CONTROL SYSTEM	HOST VOLUME REPORTS
VOICE NETWORKS	NOW	USER COMPLAINTS	CARRIER	CARRIER	NONE	CARRIER REPORTS
	NEAR FUTURE	TANDEM SWITCH ALARMS	COMMUNI-CATION TEST EQUIPMENT	REROUTING	NIGHT TESTING	SMDR

4. AT&T DATAPHONE DIGITAL SERVICE

- DDS (first announced in 1974) is the first major attempt since Datran to establish a cross-country "all digital" communications network service. DDS currently services 61 major city calling areas in the United States.

  - AT&T has announced plans to expand the service to a total of 96 cities by the end of the second quarter of 1981.

  - In addition, the company is evaluating at least 12 other city calling areas for possible inclusion, and expects to apply for FCC approval of these cities later in 1981.

- Dataphone Digital Service (DDS) is a 24-hour, seven-day-per-week service that is available on a full-period basis only. The service accomodates transmission speeds of 2,400, 4,800, 9,600, 56Kbps, and 1.544Mbps in full-duplex mode.

  - AT&T has been battling with the FCC since its first prices for DDS were disclosed in tariff #260 in 1976. The current pricing has still not received formal tariff approval from the FCC; rather the prices are based on an interim tariff allowed by the FCC awaiting further cost justification from AT&T.

  - In each city calling area, hub access is restricted to within a 50-mile radius. While AT&T has stated that current technology is in place to extend this radius up to a minimum of 75 miles, it has not obtained FCC clearance to do so.

- DDS is regulated by the FCC for interstate routes, and is area-restricted only by pending tarriff approvals, local market potentials (as perceived by AT&T) and installation timetables.

  - Six city calling areas have been added to the DDS network since July 1980, including:

- Charlotte, NC.
- Greensboro, NC.
- Raleigh, NC.
- Orlando, FL.
- Syracuse, NY.
- White Plains, NY.

- Of the remaining 35 city calling areas expected to be added to the network by second-quarter 1981, the bulk of them should be incorporated prior to the end of the first quarter 1981.

- Once the bulk of these cities have been added, it will be likely that AT&T will have announced plans for the other cities currently under consideration.

- Several cities have been rejected as hub center candidates due to dubious economic potential, but the company stated that as the service expands, larger economies of scale may change the picture for these cities.

- DDS operates on an intrastate basis in the Washington, D.C., and Harrisburg, PA, areas for primarily government applications. The company has also obtained intrastate tariffs in Pennsylvania, Maryland, Delaware, Illinois, Indiana, Michigan, New Jersey, New York, Ohio, Florida, Georgia, Montana, Texas and selected states served by New England Bell, Pacific NW Bell, Southern Bell, Mountain States Bell, and Wisconsin Bell, and in California under the auspices of Pacific Bell, for a total of 24 states.

- For long-haul, interstate routes, DDS competes with both the satellite carriers and the suppliers of private line services.

- DDS has a distinct advantage over the private line carrier offerings in that the service provides transmission speeds up to 1.544 Mbps while its competition usually does not.

- For digital data traffic, the service also has the advantage of being an "all digital" network; no expense is thus incurred by users to convert signals from analog to digital or digital to analog formats.

- DDS has been plagued with tariff ruling difficulties over its seven-year history, yet at the same time has had little problem with either direct competition from other carriers or from alternate technologies.

5. RADIO AS A LOCAL TRANSMISSION FACILITY

- Both analog and digital microwave radio systems are available to users as an alternative to carrier offerings for short-haul and long-haul transmission of voice, data or video traffic.

- Over short-haul routes, both intrastate and interstate, there are a number of suppliers of private digital microwave radio systems, which are operated in the 2 GHz, 12GHz, 18 GHz, and 40 GHz bandwidths. To date, the highest usage of digital microwave is resident in the 2 GHz band, followed closely by the usage in the 12 GHz band.

  - A major advantage of the privately owned, digital microwave system is the extremely high transmission speeds at which they operate. Most suppliers have offerings at speeds of 45 Mbps, and more recently many have extended speeds up to 90 Mbps.

  - Another potential advantage is in overall system's cost. However, the economic justification requires a large traffic volume.

  - This past year's re-allocation of the 10GHz band (more specifically the 10.565-10.680 GHz region of the band), requested of the FCC by Xerox

to accommodate its proposed XTEN network, poses the first truly competitive threat to the Telcos in terms of viable technology for local loop alternatives.

- Services in this area come not only from Xerox, but also from companies such as ASC, which expects to expand its SDX Metroline Service of a similar offering to the 10 GHz band; GTE/Telenet, which has announced plans to use available 10 GHz bandwidth to integrate digital termination system services with its packet-switching network; a consortium of SBS, Tymnet, Manhattan Cable, Aetna and M/ACOM are proposing a test between New York City and San Francisco and other companies, while not announcing plans as yet seem poised to enter the market as appropriate. These include firms such as ITT, Southern Pacific, and even Exxon according to a long stream of rather persistent rumors.

• While analog microwave radio systems are generally conceded the advantage of superior channel capacity for analog voice services, even today, digital microwave systems are rapidly overtaking the more mature technology.

- Digital microwave systems have several important advantages over analog counterparts, for data transmission including lower overall systems cost, due to the elimination of expensive analog to digital and digital to analog converters; superior digital coding formats, which provide greater resistance to atmospheric fading and rain attenuation, or more succinctly, a greater ability to be measured and corrected for than analog signals; and the use of regeneration rather than re-amplification of signals at repeater stations.

- In telephone company uses, as well as in those of the specialized common carriers, the digital microwave radio has been looked upon as the choice for data communications applications, but not for voice or video. This image is being overcome primarily by the installation of digital electronic switching apparatus. In facilities with digital switch-

ing, the cost advantages available for data traffic (digital in nature for the most part) are just and significant for voice traffic.

- For corporate and other non-telco or carrier users, digital microwave systems have been type-accepted by the FCC in the 2 GHz, 12 GHz, 18 GHz, and 40 GHz bandwidths. The bandwidths are also controlled by the FCC, and station licenses must be obtained through a procedure which takes (according to FCC records) from 60 to 90 days.

  - It is important to note that an application for a construction permit must also be obtained, and this requires a rather expensive "Non-Interference Analysis" to be conducted and submitted as a part to the application.

  - Estimates of the cost for such analysis obviously vary widely in different geographic regions of the U.S., with the more densely populated areas carrying the burden of higher costs. It has not been unusual to hear of estimates as high as $75,000 to $100,000 for such an analysis.

  - In the least congested of the bandwidths for private and industrial users, the 40 GHz band, this is rarely so; the FCC has made special accommodations in this band to stimulate its use, and the analysis is much less stringent. In fact, a user is able to plan for overcapacity in this band, a feature not permitted in any of the other available bandwidths.

- Despite seemingly high costs, digital microwave systems compare favorably with competitive technologies; remembering, or course, that private and industrial usage of any microwave system is particularly appropriate for relatively short-haul communications applications.

  - A cost comparison compiled for NASA by Western Union in a 1979 study, "18/30 GHz Fixed Communications System: A Service Demand

Assessment," examined the total costs for installation (for local distribution) of digital microwave radio, fiber-optic cables and coaxial cable systems. The study provides cost estimates in 1978 dollars, and projects these costs for the years 1980, 1990 and 2000 (all in 1978 current dollars).

COMPARATIVE PER CIRCUIT MILE COST OF INSTALLATIONS (1978 DOLLARS)

TRANSMISSION MEDIUM	1978	1980	1990	2000
Digital Microwave	$34.0	$27	$12	$ 8
Fiber-Optic Cable	34.4	21	10	7
Coaxial Cable (L-3)	38.0	35	29	27

6. SATELLITE COMMUNICATIONS

- Satellite communications are (by nature and by design) insensitive to distance for long-haul voice, data and video traffic. It is generally considered economic for these applications, by medium and heavy users at distances exceeding 500 miles.

  - When coupled with high-speed, short-haul, private, microwave, terrestrial-based systems, there is practically no area in the lower 48 contiguous United States that cannot be accessed.

  - For distances less than 500 miles, terrestrial microwave systems can prove to be more economical than satellites.

- There are currently three major satellite communications carriers:

  - Western Union.

  - American Satellite Company.

- RCA American Communications.

- All three carriers provide services at speed rates up to 56 Kbps. Higher transmission speeds are either available under certain conditions or in planning for second-generation satellite systems.

- There are several potential new entrants to the satellite carrier market, most significantly SBS and XTEN. Others that may be expected to make public future plans include:

  - ITT.

  - Exxon.

  - SPCC.

  - GTE/Telenet.

7. FIBER OPTIC CABLE SYSTEM

- The primary advantage of fiber optics is that fiber optic cables are able to carry an enormously greater amount of traffic than other transmission media. The planned FT-3 system of the Bell system will use a number of 12-ribbon, 144-fiber cables enclosed in a one-half inch polyethylene and wire sheath, each capable of carrying in excess of 40,000 voice-grade channels.

- A second advantage of fiber optics is its future economics of scale in terms of both lower systems cost and the reduction in outside plant construction costs.

  - The capacity of the FT-3 system is such that direct replacement of coaxial cable within existing conduit allows for orders of magnitude expansion without need for additional construction expenditures. The only added expense involves central office trunking equipment, and the

like which would be necessitated by expansion of coaxial cable systems as well.

- Optical fibers' progress as transmission media has magnified enormously with the recent announcements from AT&T concerning its standardization FT-3 line rates for the proposed Boston to Washington route. This route is expected to carry more traffic than all of the microwave equipment currently installed along the route.

- It is likely that other common carriers will also standardize on the FT-3 line rate (44.7Mbps) once it has been proved in usage along the Bell System route.

  - Lower-speed and lower-capacity systems will find markets in the short term in local telco loops, and in private and industrial users' facilities.

- A question lingers as to what the freed microwave systems could or would then be used for if the FT-3 operates as direct replacement.

- Private and industrial users' organizations represent an important market potential for fiber optic cable systems, but it is a potential constrained by the user organizations' ownership of rights-of-way.

  - For several firms, the campus setting of major facilities offers little constraint, and in other cases, obtaining right-of-way is less of a problem due to regional location.

- To date, few companies are actively marketing fiber optic systems to non-carrier-type organizations.

  - Leading the marketing is the Harris corporation, which has thus far installed more than 37 fiber optic cable systems for private and/or industrial users' organizations.

- The longest, successfully installed non-carrier route is an intracampus system extending over a seven-mile link.

- ITT is also making waves in fiber optics with recently installed experimental T-3 systems for Manhattan Cable, in New York City, and for Western Union.

  - Two other companies, notably Digital Communications Corporation and GTE, are expected to announce test routes late in 1980.

- In addition to voice and data trunking applications, the market for fiber optic communications is finding its way into applications for intrabuilding, computer-to-computer and computer-to-input/output devices cabling as well as a host of other applications including the provision of electromagnetically immune communications lines for monitoring high-voltage electric power stations and nearby nuclear power facilities.

8. FACSIMILE EQUIPMENT AND SERVICES

- A major obstacle to penetration of facsimile equipment usage in large companies has been, and remains to a large extent, the incompatibility of manufacturers' offerings both within product lines and with other manufacturers' equipment.

  - The development of technological standards for compatibility is a task recently completed by Study Group XIV of the CCITT (International Telegraph and Telephone Consultative Committee).

  - The CCITT has established standards, recommended for adoption by manufacturers in 1981, which have divided facsimile devices into three major groups:

    - Group I - Facsimile devices designed for operation at six-minute speeds utilizing FM analog modulation and four-minute speeds as an option.

- Group 2 - Facsimile devices intended for operation at three-minute speeds utilizing AM analog modulation and two-minute speeds as an option.

- Group 3 - Facsimile devices operable at one minute speeds which utilize digital modulation techniques and which may employ bandwidth compression and/or redundancy reduction schemes to further enhance transmit/receive speed rates.

- The adoption of the CCITT standards promises to lend significant market potential to an extremely diverse array of products.

  - Facsimile services (currently available) can generally accept most facsimile devices on the market.

  - Facsimile equipment which falls into these CCITT standards groups are shown in Exhibit VI-7.

- An alternative to establishing a private facsimile network is provided domestically by three companies:

  - ITT - FAX-PAK.

  - Graphnet - FAXGRAM.

  - Southern Pacific Communications - Speedfax.

- FAX-PAK is a service offering of ITT's Domestic Transmission Systems, which provides store and forward communications within the continental U.S. between compatible and incompatible devices.

- FAXGRAM is offered by the Graphnet subsidiary of Graphic Scanning Corporation, an FCC-authorized specialized common carrier which first offered the now-nationwide tariffed service in 1975.

EXHIBIT VI-7

AVAILABLE FACSIMILE EQUIPMENT
BY CCITT GROUPS

MANUFACTURER	GROUP 1	GROUP 2	GROUP 3	NOT CLASSIFIED
ALDEN ELECTRONICS	X			X
BURROUGHS CORPORATION	X	X	X	X
FAXON COMMUNICATIONS				X
HARRIS CORPORATION				X
INFOLINK CORPORATION				X
LITTON-DATALOG	X			X
MITSUBISHI ELECTRIC	X	X	X	
MUIRHEAD CORPORATION	X	X	X	X
NIPPON ELECTRIC CORPORATION	X	X	X	
PANAFAX CORPORATION	X	X	X	
QWIP SYSTEMS	X	X		
RAPICOM, INC.			X	
SIEMENS CORPORATION		X		
SP/DISTRIBUTED MESSAGE SYSTEMS			X	
STEWART-WARNER DATAFAX CORPORATION	X			
TELAUTOGRAPH CORPORATION				X
3M COMPANY	X	X	X	
XEROX CORPORATION	X	X		
FACSIMILE SERVICES				
FAXPAK - ITT	X	X	X	
FAXGRAM - GRAPHNET	X	X	X	
SPEEDFAX - SPCC	X	X	X	

- Speedfax is available from SPCC in 60 cities throughout the continental U.S. on any facsimile device or data terminal authorized by this specialized common carrier.

9. VIDEO CONFERENCING

- Video conferencing is the transmission and receipt of either live images or slowly changing pictures over communications lines for point-to-point or multi-point usage with television monitors.

  - The Bell System's Picturephone Service is representative of live-image technology, and slow-scan techniques are being aggressively marketed by Colorado Video.

- Further discussions of Picturephone Meeting Service and Colorado Video are in Appendix E.

10. BUSINESS CONSUMER COMMUNICATIONS

- Another mode of interorganizational communications likely to have very long-term significance in business communication applications is that of communications with the ultimate end user, the consumer.

  - One major example of this currently in place is that of audio response. This audio response capability is implemented in a number of banks, first for the use of tellers in inquiring about customer accounts, and later expanded for use by customers in similar applications. This mode of communication can be expected to expand dramatically not only in the banking industry but also in a number of other consumer-related industries.

- More formalized interfaces between consumers and major companies can be anticipated in the form of interfaces with specialized terminals, particularly the various video-based terminals.

- Experiments under way today in a number of cities (specifically Coral Gables, FL; Albany, NY; Columbus, OH; and shortly in Washington, D.C.; Austin, TX; and probably a number of others in the near future) are exploring the use of television-based terminals to communicate a variety of both information services and transaction-handling capabilities between companies and consumers in their homes.

- A longer-term and potentially even more interesting possibility is that of the use of home computers for interfacing with companies' data systems.

  - One early example of this is an experiment just recently announced by the United American Bank in Knoxville, TN, called "Express Information," which will allow home computers to interface with the bank to pay bills, receive account information and apply for loans.

- While the impact of these kinds of consumer-related application is unlikely to be felt in this marketplace until towards the end of the forecast decade, it is certain to have a significant impact not only on the communication networks but also on the knowledge of the end user in his of her relationship to information systems.

  - This latter point was referred to frequently by the respondents to the study in terms of the impacts, both good and bad, which newly knowledgeable users of data processing systems were having on corporate communications and data processing operators.

VII COMPETITIVE ISSUES AND MARKETING CONSIDERATIONS

VII COMPETITIVE ISSUES AND MARKETING CONSIDERATIONS

A. COMMUNICATION SERVICES COMPANIES

1. AT&T

- The Bell System is by far the dominant company in the communications business. This dominance derives almost exclusively from Bell's position in the voice market, but since almost the entire communications business is built upon the basic voice facilities, this voice dominance allows Bell to also dominate the data network marketplace, and to an only slightly lesser extent, the message and facsimile network markets as well.

- There are many key elements of this dominance, including:

  - Long-distance transmission facilities.

  - Local transmission facilities.

  - Inside wiring.

  - The switched telephone network.

  - A large in-place presence.

- A position in the national and local financial communities.

- Bell has a total of slightly over one billion miles of long-distance circuits in the United States. (A circuit is defined as a voice circuit or VF.)

  - These one billion circuit miles consist of about six million actual circuits and are carried on a network of almost 100,000 miles of microwave beam and coaxial cable.

- The scale factor of this plant is such that, if pure costs were to determine prices, there would be little opportunity for profitable competition against Bell along its major routes.

  - Depending on the viewer's position, the cost-price relationships in the common carrier industries have been so distorted that there are many opportunity windows in Bell's pricing through which competition can survive. (These regulatory issues are discussed further in Appendix D.)

- Having achieved this huge scale factor, Bell is in a position to expand its economic lead over potential competition by being able to afford-ultra large, ultra-high first cost, advanced technology. Such is the case with the large fiberoptic route on Bell is planning between Boston and Washington for some years hence.

- In local transmission (that is, the local loop plant that carries traffic between the long-distance facilities and the subscribers' premises), Bell has an even more dominant position, with slightly under one billion miles of circuits. In this element, the other telephone companies share this dominant position with Bell in their own territories.

- Bell's position here is more dominant because, in local transmission, there are fewer alternatives of any sort.

- In long-distance transmission a number of old and new transmission facilities operations exist. These are discussed in a later section.

- In local transmission about the only in-place public alternative is CATV and, with a few exceptions discussed later, these CATV organizations have shown few tendencies to enter the-two way communications business.

• In inside wiring, Bell has less potential for long-term dominance but certainly a huge running start on competition.

  - Until competition entered the subscriber equipment market after the 1968 Carterphone decision, Bell and the USITA companies installed all of the communications wiring on user premises. As discussed earlier in this report, the telephone companies still own 70% of the large company installations and essentially all of the household installations.

  - In this area the user has a growing number of alternatives, and Bell's dominance is already declining.

• The switched telephone network represents not just a huge and ubiquitous profit producer, but also a potential for vastly improved services, in both cost efficiency and user-valuable features.

  - The CCIS system (described elsewhere in this report) now being installed in the Bell System, has the capability to improve long-distance plant efficiency by about 10% and to provide a vast array of improved voice and other kinds of communications services.

  - The presence of a telephone connection at some 180 million physical locations, and the potential of a connection at almost any location at a very nominal initial cost, has made the switched telephone network a tremendously useful capability for the implementation of new communications services.

- In fact, without the switched telephone network almost none of the competitive services could have been started.

- For obvious reasons Bell and the USITA companies fight very hard to retain to themselves the advantages of owning such a network. (The argument posed by the competitors is that this huge network advantage was obtained by way of regulatory-granted monopolies and hence must be shared.)

• Another major competitive advantage held by Bell is its presence in the business community, with one million employees in some 30,000 operating locations. In the inherently distributed communications business, the simple presence of a trained and managed staff in a given location provides its possessor with huge advantages in both its real and its perceived abilities to provide service in that location.

  - Many of the companies in this study, particulary the companies with large facilities in remote locations, not only rely heavily on AT&T but in many cases have tried other long-distance carriers, found them wanting, and have gone back to Bell.

  - On the other hand, Bell's ultimate capabilities, its people, are regarded by most users as becoming increasingly deficient. The ratio of satisfaction to dissatisfaction with Bell's performance is about one to five in this study.

  - The primary issue of dissatisfaction with Bell is with its first-line personnel, the maintainers, operators and personnel to whom trouble is reported, etc. In general the problems encountered are attributed less to Bell management and more to outside interferences with Bell's hiring practices.

• Another apparent advantage Bell possesses is its high-level relationships in the financial community.

- One place where this advantage appears is in the banking industry, where high-level Bell executives are on the board of directors of many banks. While these executives are certainly very careful to avoid exerting influence in competitive situations, their presence on the board makes communication managers feel the need to be doubly sure of their facts when recommending the purchase of a non-Bell products.

- An entirely new situation is now evolving at Bell as a result of the Computer Inquiry II decision. Bell is in the process of organizing a new, unregulated subsidiary.

  - As discussed in Appendix D, there are many legal questions, particularly antitrust questions, yet to be resolved before this subsidiary begins to have any major impact on the communications business.

  - However, it is INPUT's belief that the legal questions will be resolved, probably by Congressional action, to allow Bell to operate such a subsidiary and that well before the end of the decade this Bell unregulated subsidiary will be providing large volumes of the most sophisticated communications equipment and services to the market-place.

- In summary, then, while Bell has sustained many cracks and dents in its industry dominance, and is in an extensive transition phase at present, Bell continues to be the dominant force in the communications industry today and will remain so throughout the decade.

  - This does not mean that major competitive opportunities will cease to appear, but rather that planners, both vendors and users, must be well aware of Bell is capabilities and probable actions, both short-term and long-term.

2. USITA

- USITA companies are the other telephone companies, some large such as GTE, Continental, United, etc., and many very small, which serve the remainder of the country not served by Bell.

- With a few limited exceptions, those companies do not operate long-distance facilities but are primarily local service operators.

  - To a large extent, these local services operate at a loss or at a marginal profit and become profitable by reason of reimbursement from AT&T for the cost of providing access to the highly profitable long-distance service. To the extent that AT&T reduces long-distance prices to meet competition, the source of these reimbursements, or "separations charges," is placed in jeopardy.

  - This issue is one of the most difficult problems the regulatory agencies have to face in balancing competition and service availability, and it is the reason why USITA members have been the most vehement of all in opposing various new types of competition.

- The USITA companies have moved faster than Bell into computerized switches, particularly PBXs, and have been very active in providing customer-owned switches.

3. OTHER COMMON CARRIERS

- These include those other companies that own and operate transmission facilities, specifically:

  - Western Union.

  - MCI.

- Southern Pacific Communications.

- ITT.

- A few intrastate microwave network operations.

- These OCCs including those operating nationwide, have networks that are much smaller than Bell's, and they tend to provide service to a limited number of high-volume locations.

- The general reaction of users to these OCC services is very geography-dependent.

  - In large locations and along-high traffic routes, the level of satisfaction is good.

  - In the smaller locations, usually newer to the OCCs, the service is regarded as poor and is attributed by the users to "overextension."

- Users are, however, looking to the OCCs and other transmission alternatives to help stabilize the long-term cost of transmission.

- OCCs are supported strongly by the independent PBX and network switch manufacturers for whom lower cost OCCs represent a major selling point in their user marketing efforts.

4. VALUE ADDED CARRIERS

- The principal value added carriers are:

  - GTE Telenet.

  - Tymnet.

- GraphNet.

- Many of Western Union's and ITT's domestic services are of a value added nature. (The concept of Value Added Network Services was explored by INPUT in 1978 in a study with that title.)

- Most of the use to which large companies put value added services is as network extensions; that is, access to lower traffic volume locations that could not otherwise be connected economically to the companies' networks.

- One of the growth strategies employed by the value added carriers, particularly GTE Telenet and Tymnet, is the provision of on-site switching equipment with which large companies implement private data networks.

- Some of these value added carriers utilize packet-switching technology to implement the offered data services.

  - In some cases, such as Tymnet, this packet-switching technology is internal to the network, and users interface to the network using more common asynchronous or bisync protocols.

  - In the case of GTE Telenet, users may also interface to the network using packet-switched type interfaces, particularly X.25.

- Bell's ACS (Advanced Communications Service), semi-announced* in mid 1978 and postponed indefinitely in early 1980, was evaluated by INPUT in October 1978.

*As the transmission backbone the ACS service, ACS was "semi-announced" by describing the service to the FCC, a very public process, and asking the FCC for permission to use Dataphone Digital Service.

- ACS, a packet switch based, value added service will, like all of the other value added services, fall into a category which the FCC has termed "enhanced services" (as opposed to "Basic Services"). All of these enhanced services have been defined as unregulated by the FCC in Computer Inquiry II.

5. SATELLITE CARRIERS

- Three companies presently have domestic communications satellites in operation:

  - Western Union.

  - AT&T/GTE.

  - RCA.

- Other companies, such as Satellite Business Systems, Hughes and Southern Pacific, have announced plans to launch satellites. (The first SBS satellite, scheduled for launch November 6, 1980, may be in position by the time this report is published.)

- The existing satellite operators have also announced plans to launch additional and/or replacement satellites of greater capabilities than those now in place.

- Some of the very large companies responding to this study have performed serious investigations of the feasibility of operating their own satellite and, while none has actually done so, neither have these companies totally eliminated such a possibility.

- Originally much of the marketing effort on communications satellites was directed toward their use as low-cost, long-distance, private-line, voice trunks. (The AT&T/GTE satellites were specifically precluded from being used in this private-line market.)

- More recently, two other applications have grown to the point of preempting almost all available satellite capacity. These are:

  - Network TV.

  - High-speed (56 KBS) data communications.

- The growth of network TV use of the satellites is attributable to a symbiotic relationship between the unique capabilities of satellites for TV broadcast and the growth of special TV networks by entrepreneurs such as Robert Wold and Ted Turner.

- The growth of high-speed data transmission has been largely the result of intense marketing work by American Satellite Corporation, a reseller of Western Union satellite circuits, and RCA. Most of the applications have been batch data transmission between computer centers, but (as noted earlier) some of their same facilities have also been used for slow-scan video conferencing.

- This situation of transmission facilities is common throughout the industry at the moment. New high-capacity satellites and lower interest rates are expected to alleviate the situation in the next few years.

6. RESALE CARRIERS

- A number of companies have developed, and more companies can be anticipated, that simply buy circuits from Bell or other carriers, subdivide these circuits into smaller channels and resell them to end users.

  - PacNet, a spinoff of Itel's communication group, is one such carrier operating out of Dallas.

- It is expected that, with sharing and resale restrictions recently lifted from WATS lines, many resellers will appear in this market even though AT&T has changed the WATS price structure to make this more difficult.

7. CATV COMPANIES

- There are 4,500 operations in the CATV market in various sections of the country, covering some 16 million homes today.

    - The local transmission facilities of those companies are inherently capable of carrying communications, at least in one direction.

    - With some modification, these facilities could be modified to carry communications in two directions.

    - Manhattan Cable is the only one of these CATV operators that appears to have a serious strategy of addressing the two-way market.

    - However, with the growing urgency of solutions to the local transmission problem, referred to earlier, it is likely that many more CATV companies will be addressing this market.

8. RADIO COMMON CARRIERS

- RCCs have historically been in the business of radio dispatching for trucking firms, contractors, etc.

- New technology, such as cellular radio and digital multiplexing of radio channels, are expanding the horizons of this aggressive business group.

    - Currently these RCCs are developing the radio paging market.

- There have been a few recent examples of firms using RCC capabilities to perform two-way data communications applications.

- It would appear very probable that the RCCs will build a useful program of specialized local communications services.

- Wideband radio channels, particularly in the Multipoint Distribution Service applications, are a potential local distribution solution, and are the subject of the next probable big FCC decision within a few months.

B. REMOTE COMPUTING SERVICES COMPANIES

- There are over 100 companies providing remote computing services, each with some level of a data communications network and some with huge networks.

- For the most part these companies have avoided involving themselves in areas that might be deemed subject to regulation. There are, of course, some exceptions.

  - Tymnet is a spinoff of Tymshare's data communications network capabilities.

  - Some firms, (e.g. ComShare and STS Services) provide mailbox services for electronic mail applications for their users.

- The Computer Inquiry II decision in May of this year has sent many of these companies back to take closer looks at the communications plans that most had previously considered and rejected.

- The enhanced services most likely to result from these reevaluations fall into two classes:

  - Transaction collection.

  - Electronic mail.

- To a large extent, most of these remote computing companies already provide these services in some form, but usually under the designation "data base management services" or something similar.

- The change that can be expected is two-fold:

  - An increase in the marketing thrust of these services to orient them directly to communications applications.

  - A thrust toward the provision of complete systems or solutions, including terminals and any other required user site hardware, user applications analysis, system installation and user training, etc.

C. OTHER SERVICES COMPANIES

- New types of communication services are being developed to serve the network market including:

  - Network data analysis services. A number of DP service bureaus have started processing the "SMDR" types (the call detail records coming from computerized PBXs.)

  - Network management services. TDX Company in McLean, Virginia, has for some years offered a shared computer service whereby users could obtain optimum call-routing services as well as call data recording for network optimization studies.

  - Network facilities management services. Southern Pacific Communications Systems Corporation was recently organized to do the design, implementation and operation of private networks for companies. Its primary orientation is toward voice data networks.

- This last area of FM services in communications is one which a few users have raised as a possible solution for these problems, particularly in the light of the growing scarcity of qualified people.

D. COMPUTER MANUFACTURERS

- The computer manufacturers, primarily IBM, have been the dominant influences on data communication networks.

  - Their dominance has not been anything approaching that of AT&T's but it has been growing.

  - The computer manufacturers' influence has been based primarily on communications software in the host computer or, more recently, in the programmable front end.

1. IBM

- By far the most dominant organization in data communications after AT&T is IBM.

- While there have been many papers and articles written, and many discussions held, about the deficiencies in IBM's various data communications systems and products, these systems and products are far ahead of their alternatives, at least in the minds and budgets of the large companies examined in this study.

- As with Bell, there is much dissatisfaction and much looking for alternatives to IBM. However, the stakes are so high for large companies that the AT&T/IBM sets of solutions are the solutions of ultimate choice.

  - The solutions are proven.

- Trained people are available.

- AT&T and IBM are present in more business locations.

- IBM's data communication product line is growing rapidly and is by far the most complete line in existence.

  - It ranges from a basic architecture, SNA, to the ultimate modem.

- A short-term deficiency, expected to be resolved in the next few months, is compatibility with international standards, specifically X.25. This is discussed in Appendix C.

- A medium-term deficiency, on which there is progress but no clear conclusion, is the support of multiple host networks, including non-IBM, and the relationship with a host-independent data network.

- A long-term problem is the lack of compatibility of the IBM concepts with integrated voice networks.

  - IBM is by no means alone in such incompatibility.

  - While packet switch solutions appear to be an answer, there is much work to be done on digital voice technology as well as standards before any clear conclusions can be reached as to what real voice/data compatibility even means.

2. THE OTHER MAINFRAME MANUFACTURERS

- The BUNCH companies (Burroughs, Univac, NCR, CDC and Honeywell) are also heading down paths of host-oriented data communications architecture.

  - Although they are in some cases trying to gain a jump on IBM by moving toward the OSA standards (to the extent they are defined), these other

computer manufacturers do not have the breadth of product line or even the completeness of architecture definition possessed by IBM.

- The BUNCH companies are the holders of that "other 5%" share of single-vendor mainframes among the large companies studied.

3. MINICOMPUTER MANUFACTURERS

- Most of the large mini manufacturers have developed a network architecture of their own.

- Recognizing that they are not likely to be the major DP supplier to their customers, the network architectures of the mini suppliers tend to be oriented toward host-independent data networks.

- Since this appears to be a growing trend among the larger and most sophisticated data network users, the mini manufacturers are expected to achieve, as a group, a high level of success as an alternative to IBM.

E. COMMUNICATIONS HARDWARE MANUFACTURERS

1. FRONT ENDS AND COMMUNICATIONS PROCESSORS

- This area includes local and remote front-end processors, packet processors, message switchers and concentrators.

- These are the products over which the configuration battles are being fought.

- At issue is the host based or hierarchical communications networks, where the basic network control is in the hands of the major host or hosts, versus the independent data network, where the hosts are effectively only a different type of terminal and network control is built into the network itself.

- The leading firms in this area are:

  - Comten.

  - Computer Communications, Inc.

  - Digital Communications Corporation.

  - Tran.

  - Codex.

- Many of the minicomputer manufacturers produce equipment that performs these functions.

2. MULTIPLEXERS

- Multiplexers range from simple frequency-division dividers of voice channels up to intelligent group band (high-speed) digital multiplexers. It is a major source of communication cost reduction for data network users.

- Voice multiplexers, which enable users to obtain one for two reductions of voice trunk facilities, are becoming available from companies such as:

  - Storage Technology Communications Corporation.

  - Northern Telecom, Inc.

- The multiplexer suppliers are often broad line manufacturers of data communications equipment. These companies include:

  - Codex.

  - General Datacomm.

  - Racal/Milgo.

  - Halcyon.

  - Digital Communications Corporation.

  - Harris Corporation.

  - TranTelecommunications Corporation.

3. MODEMS

- The modem has long been assumed to be on its way out in favor of digital transmission. It is not only surviving but, with the addition of local intelligence to diagnose not only itself, but also some of the lines and data equipment to which it is attached, it is becoming a key part of data networks.

- Some of the leading suppliers of this new generation of modems have been in the modem business for many years.

  - Bell is still the leading producer of modems and, with the Dataphone II line, is likely to hold its place.

  - IBM, while not holding a great reputation for the quality of its modems over the years, has apparently come up with a winner with its 386X line of intelligent modems.

- The other modem makers have been enhancing their lines into a complete system with network control and management capabilities.

4. TERMINALS

- The one area that seems to be in somewhat of a technology doldrum at present is that of the terminals.

- Both printers and CRTs, while continuing to be installed at a rapid rate, are in a very heavy price and delivery war at present, with little market leadership shown by anyone outside of the computer mainframe companies.

- IBM continues to dominate the CRT market with its 3270 line, now updated to include SNA capability.

- The minicomputer manufacturers, particulary DEC, Hewlett-Packard and Perkin-Elmer, have developed extensive lines of CRTs and printer terminals that are being marketed not just to their own system users but as general-use terminals.

- A problem that most of the independent terminal manufacturers have is that they have produced terminals with many presumably useful features and have now found that users are more interested in lower-cost terminals without those features.

5. SATELLITE EARTH STATIONS

- With the onset of communications satellites for use in corporate networks, an associated market is that of satellite earth stations.

- Manufacturers of this equipment tend to be the firms with specialized technology skills in the low-noise circuitry required to keep the system cost low.

- As new technologies enter this market, the lead will keep shifting, but among a limited set of suppliers, which includes the following:

  - Harris.

  - Scientific-Atlanta.

  - Motorola.

6. TELEPHONE SWITCHING EQUIPMENT

- The leadership in the PBX area is also one in which the leadership has changed every few years, except that in this market Bell has continued to represent a strong force.

- The current leader after Bell, in terms of numbers of PBX systems being installed, is ROLM.

- Other companies very heavily into the computerized digital PBX market are:

  - Digital Telephone Systems.

  - Northern Telecom.

  - Mitel.

  - NEC.

- Intecom, an Exxon Subsidiary, has, on paper, the most advanced PBX yet designed. It includes telephone instruments with built-in codes and displays as well as a partitioned switch that can be driven over fiber optic links. First installations are scheduled for early 1981.

- In the tandem switching level equipment, again Bell has a strong lead but is being closely followed by:

  - Northern Telecom.

  - Rockwell-Collins.

F. THE PURCHASING PROCESS

- The analysis of the large companies' purchasing processes proved to be revealing from a number of points of view.

- It established the level of control the communications organization had over major purchases.

  - In a very few companies it was surprisingly high.

  - In most companies it was quite low.

  - Multiple committee evaluations were the rule.

    - Technical.

    - Ultimate users.

    - Financial.

    - Management.

- It established the broad range of influences that affected the purchasing process. These influences ranged from the membership of the board of directors to the current cash position of the company.

- Most importantly for this study, it proved to be a good indicator of the qualifications of the communications manager and of the communications department.

  - There was a very direct correlation between the level of formality of the purchasing process and various other indicators of communication managers' other qualifications, such as knowledge of the network, the technology, the existing alternatives, etc.

- Most of the time the answer to the questions about the company's purchasing procedures were vague, which, when pursued, meant very informal and highly variable from one situation to another.

- These vague and/or informal purchasing practices also correlated closely with the level of network management exercised by the communication organization.

  - The companies with a formal purchasing procedure were also the companies with extensive technical control centers and call detail recording systems.

  - The companies with informal purchasing procedures tended to leave the maintenance and network analysis questions in the hands of the vendors.

- Purchasing new equipment or services was a more formal process among data communications managers than among voice communications manager, although the survey data is very thin on this point.

- In many of the cases analyzed, the entire purchasing process extended literally over a number of years.

  - Some of the companies planning significant network changes will conduct, or have already conducted, studies of the network involving data collected for at least many months. This analysis may last a large

fraction of a year. A multiple committee review process may also last many months. A potential vendor selection, spec and bid preparation, and a final vendor selection process may also last as long as a year.

G. QUALIFICATIONS OF COMMUNICATIONS MANAGEMENT PERSONNEL

- In the course of this study, about two hundred and forty communications users were interviewed. The qualifications and the influence of these people is particularly important in the development of future marketing strategies intended to address these individuals.

- The following evaluations of these persons by INPUT is necessarily subjective. However, there are a number of elements of information obtained during the course of the survey can lead to conclusions. The information used by INPUT to develop these evaluations falls into the following categories.

1. KNOWLEDGE OF THE COMPANY NETWORKS AND APPLICATION

- In many cases, particularly in the very decentralized and diversified companies, the individual interviewed either was not responsible for activities at all locations or else had responsibilities that were sufficiently diverse that his knowledge of remote applications was limited. This tended to be more true in the area of data networks than with voice networks. More of the data networks were oriented toward specific operating components, either functional or geographic, whereas voice networks in some of these same companies were corporate networks.

  - In other situations, the individual interviewed was new to the function and had not yet had the opportunity to become familiar with all of the company's networks and network requirements.

- In a number of other cases the, individual interviewed was not qualified to address the network requirements, either by reason of training or experience or, more commonly, by a simple lack of available personnel resources. This was particularly true in the voice communications area, where the communications staff appeared to be extremely thin in most cases.

2. KNOWLEDGE OF NEW TECHNOLOGY

- This measurement was perhaps the best qualification of the individuals interviewed. This evaluation was premised on the manager's knowledge of specific new technologies and also of the implications of these new technologies.

  - Again, the pattern was largely the difference between the data communications managers and the voice communications managers.

  - Apparently the datacom managers have significant available time to be able to keep up with the technical literature in their field.

  - The voice communications managers appeared to depend much more on the contacts with their peers for information on new development.

3. SCOPE OF RESPONSIBILITY

- Responsibilities ranged from complete responsiblity for all corporate communications (voice, data, facsimile, message, etc.), to situations where the corporate communications manager was basically an administrative individual responsible for purchasing common carrier facilities.

- There was little or no detectable relationship between the level of responsibility and the size of the organization. Some very large organizations had a single individual responsible for a broad range of communications functions, while some very small organizations distributed this responsibility widely to a number of different individuals.

- There was also little or no relationship to type of industry, except that the diversified financial organizations tended to have very little in the way of centralized, broad-scope communication responsibilities.

4. ORGANIZATION POSITION OF THE COMMUNICATION FUNCTION

- This factor, while easily enough established in most of the interviews, tended to be somewhat misleading in terms of what it could conceivably indicate in terms of the qualifications or responsibility of the individual.

  - In many cases, a staff individual relatively far down in a user organization had significantly more influence in terms of purchasing decisions and concept acceptance than did some high-placed individual with a title such as vice president or senior vice president in other organizations.

H. QUALIFICATIONS OF COMMUNICATIONS OPERATING PERSONNEL

- In this, case the evaluation was based on the expressions of the respondents.

- Generally, users expressed a fairly high level of satisfaction with the qualifications of operating personnel responsible for the central operations of communications and DP facilities.

- The only exception to this was a feeling of inadequacy (or, more specifically, a feeling of inadequate vendor training) in complex areas such as network diagnostic facilities.

- In all areas, the users generally felt understaffed.

- Recruiting qualified people was the most expressed problem in terms of operating personnel.

I. QUALIFICATIONS OF END USER PERSONNEL

- One of the trends identified in this as well as all other studies of communication and DP operations, is that as the systems become more on-line, as more applications are implemented, and as the user site hardware becomes capable of performing more functions, the user's ability to operate the required equipment and systems becomes a very critical problem to those responsible for managing communication networks. This factor stood out very clearly in this study.

- The primary manner in which this was stated was the great need for, and the inadequacy of, user training.

  - One area where this stood out surprisingly was in the operating of telephone services.

  - Users faced with a relatively complex telephone system with features such as camp-on, call queuing, call forwarding, etc., often did not use these services. Upon investigation by the communications managers, the reason was usually expressed as inadequate familiarity.

- The communications manager, while recognizing ultimate responsibility for such training, felt that the product vendors had provided inadequate support in this area.

VIII MARKET ESTIMATES

VIII MARKET ESTIMATES

- One of the objectives of this study was to estimate the impact that anticipated network changes will have on the market.

- This was accomplished by first establishing a quantitative estimate of the present status of large company networks.

- Then, using the users' expectations of growth and qualifying these estimates by the various anticipated other changes and their interactions, the current status was extrapolated to form a 1985 estimate.

A. LARGE COMPANY TELEPHONE MARKET - 1980

- This market, estimated by major network elements, is shown in Exhibit VIII-1.

1. LONG-DISTANCE TRANSMISSION

- Long-distance transmission includes, in the total column, both dedicated lines and a volume extrapolated estimate of dial-up lines (MTS and WATS).

- The large companies handle slightly more than half of their total traffic on private lines (PBX tie lines, Inter Machine trunks, FX lines, etc.).

EXHIBIT VIII-1

MARKET SITE ESTIMATES - FORTUNE 500/50 TELEPHONE MARKET, 1980

NETWORK ELEMENTS	INSTALLED UNITS			
	TOTAL MARKET	BUSINESS MARKET	F 500/50 MARKET TOTAL	F 500/50 MARKET: DEDICATED/LEASED
LD TRANSMISSION (MILLIONS OF VF MILES)	1,000	500	175	90
NETWORK SWITCHING (NUMBER OF SWITCHES)	24,000	NOT APPLICABLE	NOT APPLICABLE	2,500
LOCAL TRANSMISSION (MILLIONS OF VF MILES)	1,000	250 (EST)	50 (EST)	50 (EST)
PBX (NUMBER OF SWITCHES)	250,000	250,000	59,000	20,000 (NON-BELL)
INSIDE WIRING (MILLIONS OF INSTALLATIONS)	69	4	0.21	0.21
TELEPHONE INSTRUMENTS (MILLIONS OF INSTRUMENTS)	184	51	14	4 (NON-BELL)
- PBX CONNECTED	-	25	5	4
- KEY SETS OR SINGLE LINES	-	26	6	0

- The 90 million mile figure is extrapolation from survey data.

- The one billion mile total market estimate and the 500 million business market estimate come from published data.

2. NETWORK SWITCHING

- The 24,000 switch figure is derived from published data for Bell, USITA and NATA companies. It includes all levels of public network switches as well as private tandem switches.

- The installed base of private tandem switches, supplied by carriers or by independent switch manufacturers (Northern Telecom, Collins, Stromberg-Carlson, ROLM, etc.) is estimated to be about 2,500 switches. This is extrapolated from survey data.

3. LOCAL TRANSMISSION

- Bell and the other carriers have stated that there are about one billion miles of local loop plant in the U.S.

- Based on the ratio of business to residential telephones and applying some judgement both to the concentration ratios in business telephones and to the loop lengths, about 25% of this plant is estimated to be used for business telephones.

- The survey did not produce quantitative data on the applied loop plant for the Fortune 500/50 market.

4. PBX

- The total market of installed PBXs is estimated in published data to be about 250,000 systems, all of it in business.

- The number of PBXs installed in the Fortune 500/50 market was estimated at just under 60,000 systems from survey data.

  - This includes Centrex Systems as well as on-premises equipment supplied by the carriers and the interconnect companies.

- In this PBX market, the dedicated/leased column applies only to those PBXs supplied by the interconnect industry.

  - This ratio, now about one-third, has been increasing sharply over the last three years.

5. INSIDE WIRING

- Cabling between the PBX and the telephone instruments is the subject of the sharp debates currently under way on Local Data Networks versus PBX systems.

- The carriers are estimated to have installed wiring in about 69 million buildings over the decades.

  - These include about 65 million households and institutions in addition to four million business establishments.

- The 210,000 installations in the Fortune 500/50 markets is simply the total estimated number of business locations within that market.

6. TELEPHONE INSTRUMENTS

- This data is published for the total market and for the business market.

- The Fortune 500/50 portion of the market is extrapolated from survey data, with some adjustments made to the data after discussions with some of the telephone equipment manufacturers.

B. LARGE COMPANY TELEPHONE MARKET - 1985

- In most cases, the 1985 market estimates in the telephone market, shown in Exhibit VIII-2, are growth rate extrapolations from the 1980 data, with some adjustments (noted below) for anticipated changes.

- The growth rates used are a composite from the survey.

1. DEDICATED/LEASED SHARE OF MARKET

- The share of voice traffic handled by leased lines is expected to decline slightly (from 51% to 49%) due to changes in Bell's private line rates and functional enhancements to the public-switched network.

- New dedicated line service, such as from SBS, are not expected to be large enough during this period to affect the dedicated/switched ratio significantly.

- Network switches will grow slightly in number (from 2,500 to 3,000), but most of the companies that will use dedicated tandem switching systems already have them.

  - There will, of course, be a significant amount of equipment turnover within the group.

- The interconnect share of the PBX market will grow from 34% to 41%, but Bell is already fighting back with new products (Dimension and soon Antelope) and with new price structures (two-tier pricing).

  - Presumably Bell's unregulated subsidiary will be in effective operation before 1985, but probably not too much before.

EXHIBIT VIII-2

MARKET SIZE ESTIMATES - FORTUNE 500/50 TELEPHONE MARKET, 1985

NETWORK ELEMENTS	INSTALLED UNITS FORTUNE 500/50 MARKET		
	TOTAL MARKET	AAGR	DEDICATED/ LEASED
LONG-DISTANCE TRANSMISSION (MILLIONS OF VF MILES)	225	5%	110
NETWORK SWITCHING (NUMBER OF SWITCHES)	NA	NA	3,000
LOCAL TRANSMISSION (MILLIONS OF VF MILES)	55 (EST)	10	55 (EST)
PBX (NUMBER OF SWITCHES)	75,000	5	35,000 (NON-BELL)
INSIDE WIRING (MILLIONS OF INSTALLATIONS)	0.22	1	0.22
TELEPHONE INSTRUMENTS (MILLIONS OF INSTRUMENTS)	18	5	5 (NON-BELL)
- PBX CONNECTED	12	-	5
- KEY SETS OR SINGLE LINES	6	-	0

C. DATA NETWORK MARKET - 1980

- No attempt was made during this study to estimate the entire data network market, but only that portion of the market attributable to the Fortune 500/50. This is shown in Exhibit VIII-3.

1. MAJOR COMPUTER CENTERS

- The total number of major computer centers was extrapolated from survey data at 2,300 locations.

  - A major computer center was defined for the survey as the ultimate processing center for one or more data networks.

  - For most of the companies and data networks in this study, this definition was not a problem since practically all existing industrial data networks are host computer centered. However, as distributed processing, and particularly host-independent data networks, expand the definition of a major computer center will have to be revised.

2. LONG-DISTANCE TRANSMISSION

- The number of data transmission circuits, dedicated or dial-up, was obtained from the survey.

- The number of circuit miles was also obtained from the survey plus an estimate of the mileage taken from system maps obtained from many of the respondents.

- The mileage stated requires some explanation. While attempting to place this number into a common dimension, such as equivalent VFs, the following complications appeared:

EXHIBIT VIII-3

MARKET SIZE ESTIMATES - FORTUNE 500/50
DATA NETWORK MARKET, 1980

NETWORK ELEMENTS	INSTALLED UNITS FORTUNE 500/50 MARKET TOTAL
MAJOR COMPUTER CENTERS	2,300
COMMUNICATION PROCESSORS	6,000
LD TRANSMISSION	
CIRCUITS	123,000
MILEAGE*	18,500,000 MILES
TERMINALS (LEASED)	
TOTAL	1,020,000
OPERATOR	675,000
MEDIA	120,000
TRANSACTION	225,000 (ESTIMATE)
REMOTE TERMINALS	660,000
MODEMS/DSU/MUX	800,000

*EQUIVALENT TERMINAL SPEED OR VF MILES, WHICHEVER IS THE HIGHEST SPEED

- Split stream modems and group band operated multipliers.

- Wideband circuits.

- In these cases, rather than convert the data to equivalent VFs, the speed of the terminal dictated the definition of the circuit.

  - For example, a terminal operating at 2400bps on one of the channels of a 4800 bps split stream modem was treated as using a full VF circuit.

  - Conversely, a high-speed RJE terminal or distributed processor operating at 56Kbps was treated as using one full circuit.

3. TERMINALS

- The total number of terminals operated by Fortune 500/50 companies is estimated at about one million units.

- This figure is believed to be slightly low because of an understatement in the case of transaction terminals (POS, teller, credit, etc.). This understatement was corrected upward, but conservatively.

- Operator terminals include all keyboard operated devices, primarily CRTs and printers. Many of these are clustered or batch connected to the network.

- Media terminals include a wide range of devices. Most are standard RJE devices, usually 2780/3780 emulators. An increasing number of devices, classified by users as terminals, are computers of various types from S/34 to 43XX.

  - Where these computers were stated to be driving a set of remote terminals, the computer was not counted and the terminals were. However, there were many cases where this information was not obtainable and the numbers are accordingly off.

- As a result, the media terminals might be as much as 20% overstated and the operator terminals correspondingly understated.

- Many of these terminals are colocated with the major computer center.

  - From the data it can be shown that an average of over 150 terminals are colocated with the major computer centers.

D. DATA NETWORK MARKET - 1985

- As in the voice network market, the primary source of the 1985 market estimates shown in Exhibit VIII-4 is the extrapolation of growth rate estimates given by users during the survey.

1. MAJOR COMPUTER CENTERS

- The actual number of major computer centers is expected to decrease slightly during the next five years.

- There are two problems with the use of this estimate.

  - It has the definition problem referred to earlier in that, particularly by 1985, there will be a number of companies with host-independent networks and multiple-host type nodes.

  - The users' estimates of future trends in this area do not account for acquisitions and new business areas which may be established, with computer centers, within their companies.

- The data were adjusted to compensate for these considerations - but again, conservatively.

EXHIBIT VIII-4

MARKET SIZE ESTIMATES - FORTUNE 500/50
DATA NETWORK MARKET, 1985

NETWORK ELEMENTS	INSTALLED UNITS FORTUNE 500/50 MARKET TOTAL	AAGR
MAJOR COMPUTER CENTERS	2,200	NEGATIVE
COMMUNICATION PROCESSORS	15,000	20%
LD TRANSMISSION		
- CIRCUITS	360,000	24
- MILEAGE* (LEASED)	48,000,000	21
TERMINALS		
- TOTAL	2,400,000	20
· OPERATOR	1,500,000	18
· MEDIA	350,000	24
· TRANSACTION	550,000	20
- REMOTE TERMINALS	1,700,000	21
MODEMS/DSU/MUX	2,000,000	20

*EQUIVALENT TERMINAL SPEED OR VF MILES, WHICHEVER IS THE HIGHEST SPEED

- The raw data from users would have put the number of centers below 2,000.

2. LONG-DISTANCE TRANSMISSION

- The market estimate is a direct extrapolation, using 21% AAGR.

- The increasing use of wideband circuits and terminals is not reflected in these numbers.

3. TERMINALS

- In this case, with the exception of the transaction terminals, the growth data appears to be reasonable and the market forecasts usable as such.

- While the media/operator terminal mix has the same problem referred to earlier, the media terminals are unquestionably growing faster than any of the other categories.

  - This, of course, is primarily attributable to the rapid growth of small computers within the network, a subject not directly investigated in this study but examined in some detail in another 1980 study by INPUT, "Selling Personal Computers To Large Companies."

E. FACSIMILE NETWORK MARKET

- The estimated total size of the facsimile market among the Fortune 500/50 companies is estimated to be 62,000 units installed in 1980 as shown in Exhibit VIII-5.

- The 1985 estimate, based on users' growth expectations, is almost 200,000 units installed in this market.

EXHIBIT VIII-5

MARKET SIZE ESTIMATES - FORTUNE 500/50
FACSIMILE NETWORK MARKET, 1980-1985

TYPE OF FACSIMILE DEVICE	NUMBER OF DEVICES INSTALLED		AAGR
	1980	1985	
CLASS 1 4 TO 6 MINTUES	36,000	42,000	3%
CLASS 2 2 TO 3 MINUTES	24,000	120,000	38
CLASS 3 1 MINUTE	2,000	13,000	45
TOTAL	62,000	175,000	23%

- Two major situation changes could change this forecast significantly:

  - Facsimile units could be replaced by electronic mail systems in large numbers. INPUT's assumption is that this will not happen to any great extent before 1985, but will slow the growth rate of facsimile in the later 1980s.

  - Communication managers, now attempting to gain some level of control over facsimile networks, could, by this control, reduce the growth rate. INPUT's assumption is that communication managers will achieve control over facsimile networks but in so doing will enhance the available services to facsimile users and might even increase the growth rate.

- There is a distinct pattern to the growth rates of different types of facsimile equipment with faster machines, growing at a significantly faster rate than slower machines.

- In spite of estimates to the contrary, it appears that the slower machines are continuing to grow, apparently into new applications.

  - This new application area is one where the respondents to this study are generally not well qualified and INPUT believes that the estimates of growth of low-speed machines given by respondents were, in fact, optimistic. The 3% growth rate is an adjustment made by INPUT to the 20% growth rate obtained from the survey.

F. MESSAGE NETWORK MARKETS

- Overall message networks exhibit a sharp decline during the next five years, as shown in Exhibit VIII-6.

EXHIBIT VIII-6

MARKET SIZE ESTIMATES - FORTUNE 500/50
MESSAGE NETWORK MARKET, 1980-1985

TYPE OF MESSAGE NETWORK	NUMBER OF DEVICES INSTALLED		AAGR
	1980	1985	
TELEX/TWX	8,500	11,000	5%
PRIVATE NETWORK	37,500	22,000	-10
TOTAL	46,000	33,000	-6%

- This is primarily (almost exclusively) attributed to the conversion of private wire message networks to integrated data networks, or in a few cases, to electronic mail networks.

- Telex/TWX networks, used by large companies primarily for communication with other companies and for international applications, will continue to grow at a relatively slow pace.

- Some of the largest networks (300 stations and above) are not being converted during the next five years. In fact, there are plans to upgrade the user terminals during this period. However, this situation is likely to change toward the latter years of the decade.

G. ELECTRONIC MAIL MARKETS

- One of the major problems in estimating the size of the electronic mail market is that most of the electronic mail systems installed are using terminals installed for some other application (word processing, analytical timesharing, message services, etc.).

- About 35% of the companies interviewed have an electronic mail system or service, or both, in use today. An additional 15% of the companies are planning on such a system or service in the near future.

- Extrapolating these estimates to the entire Fortune 500/50 marketplace, the electronic mail user will be:

  - Present users - 280 companies.

  - Planning to use - 120 companies.

- An interesting point to note is that a very high percentage of the companies using electronic mail today are themselves involved in the electronic mail market in some way. For example:

  - Computer manufacturers.

  - Communication carriers.

  - Remote computing service providers.

  - Terminal manufacturers.

- Most of the other companies using electronic mail have either a large engineering staff at multiple locations or a large data processing staff, also at multiple locations.

H. GEOGRAPHIC DISTRIBUTION OF MARKETS

- The distribution of the end points (telephone instruments and remote terminals) is approximately the same as the distribution of locations, as shown earlier in Exhibit III-5.

- The distribution of key market elements, specifically major voice switching centers and major data centers is shown in Exhibit VIII-7.

- Generally the voice centers tend to track the distribution of overall company locations and the distribution of data centers more closely resembles that of headquarter locations.

- Some of the distortions between these two types of distributions are caused by large banks and utility companies with their inherently local distribution of all types of facilities.

EXHIBIT VIII-7

GEOGRAPHIC DISTRIBUTION OF KEY MARKET ELEMENTS IN THE FORTUNE 500/50 MARKET
(PERCENT OF TOTAL)

GEOGRAPHIC REGION	MAJOR VOICE-SWITCHING CENTERS	MAJOR DATA CENTERS	TOTAL COMPANY LOCATIONS	FORTUNE 500/50 HEAD-QUARTER LOCATIONS
NEW ENGLAND	7%	7%	5%	9%
MIDDLE ATLANTIC	24	23	17	28
EAST NORTH CENTRAL	19	27	17	25
WEST NORTH CENTRAL	5	7	7	6
SOUTH ATLANTIC	16	12	16	9
EAST SOUTH CENTRAL	4	5	5	2
WEST SOUTH CENTRAL	9	7	13	7
MOUNTAIN	2	2	5	2
PACIFIC	14	10	15	12
TOTAL	100%	100%	100%	100%

I. MARKET ESTIMATES IN DOLLARS

- Exhibits VIII-8 through VIII-14 convert the unit forecasts previously given above into dollars.

EXHIBIT VIII-8

MARKET SIZE ESTIMATES - FORTUNE 500/50

TELEPHONE MARKET, 1980

NETWORK ELEMENTS	TOTAL MARKET (ANNUAL USER EXPEN-DITURE) ($ MILLION)	NEW INSTALLATIONS (IF SOLD COST)		
		TOTAL ($ MILLION)	INDEPENDENT MANUFACTURERS' SHARE	
			PERCENT	($ MILLION)
LD TRANSMISSION	$1,100	N.A.		
NETWORK SWITCHING	300	$ 200	30%	$ 60
LOCAL TRANSMISSION	INCLUDED IN LD TRANS-MISSION	N.A.		
PBX	1,300	750	33	250
INSIDE WIRING	INCLUDED IN TELEPHONE INSTRUMENTS	INCLUDED IN TELEPHONE		
TELEPHONE INSTRUMENTS				
PBX CONNECTED	900	300	33	100
KEYSETS OR SINGLE LINES	1,300	300	15	45
PUBLIC TELEPHONE SERVICE (INCLUDING WATS)	1,500	N.A.		
TOTAL	$6,400	$1,500	30%	$450

EXHIBIT VIII-9

MARKET SIZE ESTIMATES - FORTUNE 500/50

TELEPHONE MARKET, 1985

NETWORK ELEMENTS	TOTAL MARKET (ANNUAL USER EXPENDITURES)		NEW INSTALLATIONS (IF SOLD COST)				
			TOTAL		INDEPENDENT MANUFACTURERS SHARES		
	$ MILLION	AAGR	$ MILLION	AAGR	PERCENT	$ MILLION	AAGR
LD TRANSMISSION	$1,650	8%	NA	-	-	-	-
NETWORK SWITCHING	360	4	$ 200	0%	50%	$ 100	11%
LOCAL TRANSMISSION	INCLUDED IN LD TRANSMISSION						
PBX	1,700	6	1,125	8	50	500	18
INSIDE WIRING (MILLIONS OF INSTALLATIONS)	INCLUDED IN TELEPHONE INSTRUMENTS						
TELEPHONE INSTRUMENTS							
PBX CONNECTED	1,200	6	600	15	50	300	25
KEYSETS OR SINGLE LINES	1,600	4	600	15	25	150	27
PUBLIC TELEPHONE SERVICE (INCLUDING WATS)	2,000	6	NA	-	-	-	-
TOTAL	$8,500	6%	$2,500	11%	44%	$1,100	19%

EXHIBIT VIII-10

MARKET SIZE ESTIMATES - FORTUNE 500/50
DATA NETWORK MARKET, 1980

NETWORK ELEMENTS	NEW INSTALLATIONS PER YEAR			
	UNITS	$ MILLION	INDEPENDENT VENDORS' SHARE	
			PERCENT	$ MILLION
COMMUNICATION PROCESSORS	1,800	$ 116	45%	$ 52
LD TRANSMISSION - LEASED	N/A	350	10	35
- DIAL-UP	N/A	200	10	20
TERMINALS - OPERATOR	120,000	225	65	145
- MEDIA	30,000	425	70	300
- TRANSACTION	45,000	50	50	25
MODEMS/DSU/MUX	170,000	200	80	160
TOTAL	N/A	$1,566	47%	$ 737

EXHIBIT VIII-11

MARKET SIZE ESTIMATES - FORTUNE 500/50
DATA NETWORK MARKET, 1985

NETWORK ELEMENTS	NEW INSTALLATIONS PER YEAR					
				INDEPENDENT VENDORS' SHARE		
	UNITS	$ MILLION	AAGR	PERCENT	$ MILLION	AAGR
COMMUNICATION PROCESSORS	2,600	$ 170	9%	60%	$ 100	16%
LD TRANSMISSION						
- LEASED	N/A	1,050	21	25	260	40
- DIAL	N/A	720	25	20	145	40
TERMINALS - OPERATOR	270,000	475	16	65	310	16
- MEDIA	84,000	1,700	32	75	1,275	33
- TRANSACTION	110,000	175	28	60	100	35
MODEMS/DSU/MUX	420,000	325	10	75	240	8
TOTAL	N/A	$4,600	22%	65%	$2,430	25%

EXHIBIT VIII-12

MARKET SIZE ESTIMATES - FORTUNE 500/50
MESSAGE NETWORK MARKET, 1980-1985

TYPE OF MESSAGE NETWORK	USER EXPENDITURES ($ MILLION)		AAGR
	1980	1985	
TELEX/TWX	$ 18.7	$27.5	8%
PRIVATE NETWORK	103.1	68.2	-8
TOTAL	$121.8	$95.7	-5%

EXHIBIT VIII-13

MARKET SIZE ESTIMATES - FORTUNE 500/50 FACSIMILE NETWORK MARKET, 1980-1985

TYPE OF FACSIMILE DEVICE	NEW INSTALLATIONS PER YEAR				AAGR
	1980		1985		
	UNITS	$ MILLION	UNITS	$ MILLION	
CLASS 1 4 TO 6 MINUTES	4,000	$ 4.8	0	$ 0	NEGATIVE %
CLASS 2 2 TO 3 MINUTES	6,000	14.4	40,000	72	38
CLASS 3 1 MINUTE	800	9.6	4,200	42	34
TOTAL	10,800	$28.8	82,000	$114	32%

NOTE: THIS ESTIMATE INCLUDES EQUIPMENT ONLY; TRANSMISSION COMPONENT IS INCLUDED IN VOICE MARKET.

EXHIBIT VIII-14

MARKET SIZE ESTIMATES - FORTUNE 500/50
TOTAL COMMUNICATIONS NETWORK MARKET, 1980-1985

NETWORK SEGMENT	TOTAL MARKET ($ MILLION)			AVAILABLE TO INDEPENDENT VENDORS ($ MILLION)		
	1980	1985	AAGR	1980	1985	AAGR
VOICE TELEPHONE	$6,400	$ 8,500	6%	$ 450	$1,100	20%
DATA NETWORKS	1,566	4,600	24	737	2,430	27
MESSAGE NETWORKS	121.8	95.7	NEGATIVE	121.8	95.7	NEGATIVE
FACSIMILE NETWORKS (EQUIPMENT ONLY)	28.8	114.0	32	28.8	114.0	32
TOTAL	$8,116	$13,110	10%	$1,337	$3,740	23%

APPENDIX A: GLOSSARY

APPENDIX A: GLOSSARY

A. VOICE SWITCHING CONCEPTS

1. PBX

- Private Branch Exchange. A private voice switching system serving an organization entity and located on the customer premises. On a PBX, calls can be made between stations on that premises and to and from external networks such as the public telephone network or other company locations.

2. CBX (COMPUTERIZED BRANCH EXCHANGE)

- This is a term generally used in the industry to describe a stored program computer driven PBX. It should be noted that the fact that a PBX is controlled by a computer does not necessarily mean that the switching is in fact performed by digital technology. In the Dimension PBX, for example, the switching is of amplitude modulated or analog pulses.

3. CENTREX

- A service for customers, functionally equivalent to a PBX, in which the switching functions are performed in a telephone company central office.

4. TANDEM SWITCHING

- A switch which interconnects trunk lines (that is lines between switches.) Often, in newer kinds of PBX equipment, tandem switching capability and PBX switching capability are combined. A key difference between a PBX and a tandem switch is the amount of traffic expected on an incoming line. On a PBX, the amount of traffic from an individual station is relatively small, in the order of 20 minutes per day. On a trunk line from another switch, the traffic may be several times that volume.

5. ETS (ELECTRONIC TANDEM SWITCHING)
ETN (ELECTRONIC TANDEM NETWORK)

- ETN is a name given by Bell to their modern private tandem switching systems provided to medium to large customers. It is a network in which PBX's are interconnected by private lines through a tandem switch. The ETS or Electronic Tandem Switch may be on AT&T premises in the form of a ESS Centrex Systems or it may be located on the customers premises in the form of a Dimension PBX.

6. KEY SET

- A Key Set is an arrangement of telephone stations located on a customers premises which allows any station to connect to outside lines to the Bell network. It does not allow communications between stations on the premises except by means of a separate intercom system often associate with the Key Set.

7. ACD (AUTOMATIC CALL DISTRIBUTOR)

- A system for automatically distributing incoming calls evenly to operator or attendant positions. Without an automatic all distributor the first answering position in a group would receive calls continually whereas the last position would only receive call when all other positions were busy. The ACD provides

these on a uniform basis. The AT&T version of this is entitled "Uniform Call Distributor." A requirement for this kind of capability is common among large answering applications such as reservation centers.

8. SPACE DIVISION SWITCHING

- A method for switching circuits in which each connection through the switch takes a physically separate path. Basic electromechanical switches, such as step-by-step or cross-bar are space division.

9. TIME DIVISION SWITCHING

- A process of switching time division multi-plexed circuits by shifting the data from one time slot on an incoming line to a different time slot on an outgoing line. Most new digital switching systems operate with this kind of a process as opposed to a space division switching method. The form of the actual switching should not be confused with the stored program computer which can be used to control either type of switch.

10. DID

- Direct Inward Dialing. A method where each station on a PBX can be addressed by incoming callers as a unique station number. DID was originally available only on Centrex.

11. AIOD

- Automatic Identified Outward Dialing. A process whereby a station on a PBX can originate calls into the public telephone network and have those calls identified to the individual station.

12. PEG COUNT

- A count of all calls offered to a trunk group usually measured for an hour. As applied to units of common control switching systems peg count or carried peg count means the number of calls actually handled during a one hour period.

B. VOICE TRANSMISSION CONCEPTS

1. TRUNK

- The trunk is a communication channel between two switching systems. It may also include lines between a subscriber location and a telephone company central office. These latter kinds of trunk lines are referred to as local loops.

2. TRUNK GROUP

- A number of trunks that can be used interchangeably between a pair of switches.

3. IMT

- Inter Machine Trunk. A trunk connecting two tandem switching systems.

4. DIAL REPEATING TIE LINES

- PBX tie trunks, used for interconnecting PBX equipment, which are capable of handling PBX station signaling information without attendant assistance.

5. CO TRUNK

- Central Office Trunk. A channel connecting a PBX to the central office of the telephone ocmpany. Often termed a local loop.

6. FX (FOREIGN EXCHANGE)

- A connection between a user location and a remote public telephone exchange whereby the user can send or receive calls as though he were a subscriber in that foreign exchange. The line between the foreign exchange and the user location is a private line.

7. HYBRID OR HYBRID COIL

- This is an electrical circuit used to couple four wire circuits to two wire circuits. The telephone set is a four wire device. The local line which connects the telephone to the telephone switching system is normally a two wire circuit. A hybrid is used to couple the telephone into that two wire local loop. It is at this hybrid where echoes which need to be suppressed on long distance circutis are generated.

8. TELPAK

- A bulk private wire service offered by the telephone companies. TELPAK C is a 60 voice channel group and TELPAK D is a 240 voice channel group. The continuing existence of TELPAK has been a subject of controversy for many years and it is scheduled to be eliminated as of the end of 1980.

9. T-CARRIER

- A hierarchy of digital systems designed to carry speech and other signals in digital form. Designated T1, T2 and T4. T1 carrier operates at 1.544 megabits. T2 operates at 6.312 megabits and T4 operates at 274 megabits. The Bell System is the primary user of T-Carrier systems and has about one hundred million voice circuit miles of such facilities in place. This represents approximately half a million T-Carrier circuits.

10. ECHO SUPRESSION

- A process for deliberately inserting loss in the opposite direction of speech transmission for suppressing echoes of the transmittors voice as reflected from the destination. In the public telephone network, echo supressors are used on circuits longer than 1,850 miles. Echo supression becomes a critical problem in two areas of communications.

  - The first is in the use of telephone network for full duplex data communications in which the echo suppressor will effectively eliminate one direction of transmission. To eliminate this effect, special signaling is built into modems designed for use on the telephone network. This signaling removes the echo suppressors from the transmission path.

  - Secondly, on satellite channels where the transmission delay is approximately one quarter second, an inadequate level of echo suppression on a voice conversation can result in an echo which is very pronounced and disturbing to the speaker.

11. COMPANDOR

- This is an abbreviation for compressor-expander. Companding is a process which compresses the higher amplitude parts of a signal and expands the lower amplitude parts of a signal on the transmitting end and then reverses the process on the receiving end. It is usually a process which precedes a modulation process in order to improve the signal to noise ratio on a transmitted signal without greatly increasing the required bandwidth.

12. TASI (TIME ASSIGNMENT SPEECH INTERPOLATION)
DSI (DIGITAL SPEECH INTERPOLATION)

- This is a process whereby multiple voice conversations can be transmitted over a reduced number of lines by making use of the gaps in typical voice

conversations. Normally, only one speaker at a time is transmitting which, thereby, cuts the amount of traffic in half. In addition, most speakers have some fraction of time between words or phrases. TASI and, now more efficiently DSI, take advantage of these gaps to place one voice conversation on about 45% of the otherwise required bandwidth.

13. IN BAND SIGNALING

- Signaling that uses the same path as a message and in which the signaling frequencies are in the same frequency range as used for the basic communications. The alternative method of signaling is out-of-band signaling. The Common Control Inter-office Signaling System is a method of out-of-band signaling.

14. E&M SIGNALING

- A telephone signaling arrangement characterized by the use of separate path for the signaling and for the voice signals. The M lead (derived from mouth) transmits ground or battery to the distant end. The E lead (derived from ear) receives either a grounded or open condition.

15. TIP AND RING

- The two conductors associated with a two wire cable pair. The terms tip and ring derive their names from the physical characteristics of an operator's plug on a manual switchboard.

C. PUBLIC SWITCHED TELEPHONE CONCEPTS

1. CO (CENTRAL OFFICE)

- A telephone company building or switching center which is the initial location at which subscriber lines or PBX trunks are terminated into the telephone company system.

2. CLASS 5 OFFICE

- A local central office that serves as the network entry point for subscriber lines. It is also called an end office. Other offices, classes 1, 2, 3, and 4, are toll offices or tandem offices in a telephone network.

3. NPA

- Numbering Plan Area. The area code system by which telephone directory numbers are sub-grouped geographically. A three digit, NO/1X or NXX code is assigned to each NPA where:

  - N = any digit 2 through 9.

  - 0/1 = 0 or 1.

  - X = any digit 0 through 9.

4. SERVICE CODE

- A code, typically of the N11 series such as 411 (directory assistance) and 911 (emergency), that defines a connection for a service rather than a connection to a customer.

5. CCIS (COMMON CHANNEL INTEROFFICE SIGNALING)

- This is a system being implemented on the public telephone network whereby the signaling information such as dial information is transmitted separately from the actual voice circuit connection. This dial information is sent to a common data base which then translates the information into instructions to the network switching equipment to establish the appropriate connection.

  - In addition to reducing the call setup time and reducing the amount of time that the trunks are tied up with handling of dialing information, this capability opens many new opportunities for new services. For example, one possibility is the ability to translate a number as dialed into a different number depending on the status of the location being dialed or on the place from which the call was originated.

D. DATA TRANSMISSION CONCEPTS

1. MODULATION

- A process of converting signals into frequencies such that they can more efficiently be transmitted over the transmission circuits. It often is related to the conversion of digital data pulses to transmission frequencies.

2. FM (FREQUENCY MODULATION)

- This technique, the same one used in FM broadcasting, is used extensively in voice communications to place voice signals onto a transmission media such as a wire or a radio channel or microwave beam.

3. MODEM OR DATASET

- A contraction of the words modulator and demodulator signifying an equipment unit that peforms both of these functions. In addition to the modulation and demodulation function a modem also performs other line interfacing functions. Hence data set is in fact a more appropriate term.

4. FSK (FREQUENCY SHIFT KEYING)

- A modulation technique for transmitting digital information having two or possibly more discrete states. Each of the discrete states is represented by an associated frequency. The most common form is binary FSK which uses two frequencies to represent the two states. Most basic low-speed modems use FSK modulation.

5. PSK (PHASE SHIFT KEYING)

- A modulation technique for transmitting digital information in which that information is conveyed by selecting discrete phase changes of the carrier signal.

6. PAM (PULSE AMPLITUDE MODULATION)

- This is a technique of breaking up a continuous analog signal into individual pulses, the amplitude of each pulse representing a sample of the analog signal at a particular point in time. The analog signal is usually sampled at a rate of two or more times the highest frequency. In voice communications, the normal frequency range for voice is four kilohertz, therefore the sample is at either 8,000 or 16,000 pulses per second. It is these PAM signals which are switched by the ESS and by the Dimension equipment of AT&T.

7. PCM (PULSE CODE MODULATION)

- In this technique, the analog signal is converted to pulses as before but the individual pulses are no longer left in their amplitude form, they are measured and converted into a digital representation or code. PCM is used in most digital transmission systems particularly the T-Carrier series of AT&T.

8. DELTA MODULATION

- This is another technique in which the signal is not directly converted to a digital code but rather changes in the signal from one sample time to the next are encoded.

9. QAM

- Quadrature Amplitude Modulation. A modulation system in which two independent signals are impressed on carriers of the same frequency which are 90 degrees out of phase with respect to one another.

10. MUX (MULTIPLEXING)

- This is a technique in which multiple channels of communication are combined in a way that they can be transmitted on a single physical channel.

11. FDM (FREQUENCY DIVISION MULTIPLEXING)

- This multiplexing technique uses frequency modulation to place communication channels at different frequencies within the same physical transmission path.

12. TDM (TIME DIVISION MULTIPLEXING)

- This technique uses some form of pulse modulation to place pulses from multiple channels sequentially onto a transmission path. T-Carrier is a time division multiplexing transmission system.

13. REVERSE CHANNEL OR SECONDARY CHANNEL

- A feature of certain data sets or modems which allow simultaneous transmission (usually of control or pacing information and usually at lower speeds than the primary channel) from the receiver to the transmitter over a basically half duplex data transmission channel.

14. EIA INTERFACE

- A set of standard signals and signal characteristics specified by the Electronic Industries Association. This terminology usually refers to the RS-232 C interface referred to elsewhere in this report. The RS-232 C is being replaced on an interim basis by the RS-449 interface and ultimately by the X.21 interface.

15. DUV (DATA UNDER VOICE)

- An arrangement for transmitting 1.544 megabyte per second datastreams in the bandwidth available underneath the portion of the microwave radio beam used for voice channels. DUV is the primary long haul transmission facility used for Dataphone Digital Service.

16. ERROR RATE

- A measure of the performance of a digital transmission sysem. It can be specified as a bit error rate or as a byte error rate (the probability of an error per byte transmitted or the accumulated number of byte errors in a period of time) or as a block error rate (the probability of one or more errors in a

specified length block of bytes) or in other forms such as percent error-free seconds.

17. ARQ

- Automatic Repeat Request. A system for controlling data transmissions based on requesting retransmission upon detection of an error. There are two basic classes of ARQ systems--stop and wait ARQ and continuous ARQ.

  - In the stop and wait ARQ method, a block is not transmitted until the positive acknowledgment is received from the preceding block.

  - In the continuous ARQ, blocks are continuously transmitted until the receipt of a negative acknowledgment at which time the transmitter will either repeat the specific block defined as in error or will go back to that block and repeat that block and all subsequent blocks. The first method is called selective repeat ARQ and the second method is called Go-Back-n ARQ. IBM's Bi Synch transmission method is a stop and wait ARQ. SDLC is Go-Back-n ARQ.

18. TDMA

- Time Division Multiple Access. A method for sharing a multi-point or broadcast channel among users at different geographic locations by means of an allocation of different time slots to different users. It is this type of system which is to be used by SBS in their planned satellite communications service.

19. CODEC

- Coder-Decoder. This is a device used to convert analog signals, such as voice, into digital form for transmission over a digital medium. This is the reverse process of a Modem which converts digital signals into analog form for transmission over a analog medium. At present, a Codec is a relatively

expensive unit which is shared at a common carrier location or at a PBX. In the very near future, the Codec will be reduced in price to the point where it will likely be incorporated into every telephone hand set and the lines connecting a telephone to the nearest switching location will be operated digitally.

E. COMMUNICATION SYSTEM CONCEPTS

1. CONCENTRATOR

- A switching system which allows a smaller number of trunk lines to be shared by a larger number of subscriber lines.

2. MESSAGE SWITCHING

- A process of receiving a message, storing and then retransmitting that message. This term is often used interchangeably with store and forward switching.

3. FAST CIRCUIT SWITCHING

- A form of switching for interactive traffic in which a circuit is established not for the duration of a session but for each message in such an interactive session. The technique is somewhat analogous to TASI as used for voice circuits.

4. ALTERNATE ROUTING

- A predefined "other" route used for particular situations, especially circuit failures.

5. ADAPTIVE ROUTING

- A system for routing connections which is automatically adjusted to changes in the network such as circuit failures or high traffic delays.

6. MULTI-POINT CIRCUIT

- A single circuit connecting three or more locations.

7. POLLING

- A multi point circuit control mechanism whereby a center calls each station on the circuit in turn to ask if there is any information to be transmitted.

8. SELECTION

- A process of controlling a multi point line whereby the station to receive information is addressed uniquely and data is transmitted on the circuit and recognized only by the selected station.

9. TECHNICAL CONTROL CENTER

- A facility for the diagnosis and control of the transmission network.

10. TWO TIER TARIFFS

- A tariff structure providing for a decrease in monthly equipment charges after a contracted period.

11. SERVICE TARIFFS

- Tariffs filed primarily on the basis of value of service provided and secondarily on the cost of the serving vehicle. For example, local exchange rates are usually based on the number of telephones in the exchange area rather than on the type of switching system serving the particular exchange area.

APPENDIX B: INTRODUCTION TO DIGITAL TELECOMMUNICATIONS TECHNOLOGY

APPENDIX B: INTRODUCTION TO DIGITAL TELECOMMUNICATIONS TECHNOLOGY

- Telecommunications, like most other aspects of today's world, is being influenced to a greater extent by the digital processing revolution. As costs for digital processing technologies continue to drop at a rapid rate, digital telecommunications alternatives will continue to proliferate. This discussion will provide an historical background of telecommunications in its various forms and will explore milestone digital technologies as they have been introduced. Trends for future digital technologies will be explored within the categories of processing, transmission and switching. Traditional network structures and transmission media will also be explored.

A. NETWORK ORGANIZATIONS

- Over the years a variety of network organizations have been utilized for both local access and backbone systems, and are usually combined in the overall voice or data network. The organizations discussed include:

  - Point to point.

  - Contention.

  - Multidrop.

  - Frequency Division Multiplexing.

- Time Division Multiplexing.

- Statistical Time Division Multiplexing.

- Intelligent Time Division Multiplexing.

- Concentration.

- Packet Switching.

- Most of these organizations have been utilized for both voice and data while at the current time data has received a greater level of development and deployment.

- This emphasis on data communications is attributable to the fact that data communications are essentially involved with computers which can be scheduled down to the micro second level. Voice communications inherently involved random human originated events for which digital control technologies have only recently emerged.

I. POINT TO POINT NETWORKS

- In the voice enviornment dedicated point to point paths are dictated by requirements for fast connection (e.g. trading wires in brokerage applications) where switching and dialing delays are unacceptable. Avoidance of switching and dial delays are also mandatory for inquiry response data systems. Dedicated point to point systems are also required for high speed batch data applications where high throughout eliminates the potential sharing or contention.

- A strictly point to point network would obviously require a large number of circuits if each point was to be connected to every other point. The number of circuits for a fully connected network is derived with the following formula:

- Circuits = $\frac{n^2 - n}{2}$.

To connect 100 points our formula tells us that 4,950 circuits would be required.

2. CONTENTION NETWORKS

- The infeasibility of pure point to point networks prompted network designers to use hierarchical switched systems, which function more economically by exploiting the random origination and usually, low utilization of tributary networks. These switched systems for voice and data operate on a contention basis. Under momentary traffic surges the local access user will receive a busy signal if his call is the one exceeding the number of backbone paths leaving the contention point. Carefully designed contention systems can exploit favorable traffic distribution probabilities to provide good levels of service.

- Contention systems (e.g. PBX's) have been popular because of their low cost and simplicity. Contention systems for either voice or data are unacceptable where overload (blocking) would prohibit the establishment of connection. Because contention systems must be designed to handle peak loads of randomly generated traffic line utilizaton is lower than active control (e.g. polled) systems where events can be scheduled.

3. MULTIDROP NETWORKS

- Another popular organization for local access networks is multidrop. This familiar approach strings multiple data terminals on a single circuit. Transactions are solicited by polling and delivered by selection using address codes specifying the desired terminal. These systems usually operate on voice grade analog facilities utilizing modems at speeds between 1200 and 4800bps.

- Voice utilization of the multidrop organization is most frequently used in party lines where the number of rings specifies who is to pick up.

  - A selective signaling systems (SS-1) utilizes a similar approach on leased voice grade lines.

  - A highly specialized organization called a "Hoot and Holler" system connects multiple locations with broadcast speakers where no control (other than who is speaking) is available.

4. FREQUENCY DIVISION MULTIPLEXING (FDM)

- Multiplexing, in general, subdivides a larger channel, or trunk, into frequency sub-bands. Frequency Division Muiltiplexing (FDM) subdivides the trunk circiut into fixed frequency bands. In both FDM and TDM the amount of data or voice cannot exceed the total channel capacity of the trunk in either connections (voice) or through-put (data).

- FDM will continue to be used by common carriers for long haul (+500 miles) transmission of voice principally because analog voice can be transmitted cost effectively at 4,000HZ and frequency multiplexed over wideband analog coaxial cables. and microwave systems. FDM is becoming obsolete for data transmission due to favorable price performance relationships for digital processor oriented TDM.

5. TIME DIVISION MULTIPLEXING (TDM)

- Time Division Multiplexing subdivides the backbone channel into fixed time slots. TDM has become popular for the short haul transmission of voice traffic with the Bell developed "T" family of carriers. These systems provide advantages in maintainability and reliability since they are digital and because they are linked to improving price/performance relationships for LSI technologies.

- It should be noted that "T" systems utilize Pulse Code Modulation (PCM) (discussed in greater detail later) and as such a voice channel occupies 64kbs rather than 4 KHZ.

- TDM systems for data communications have become more popular since the early 1970's and now offer reliable, inexpensive networking capabilities because they have and will continue to ride the declining LSI cost curve.

6. STATISTICAL TIME DIVISION MULTIPLEXING (STDM)

- Statistical Time Division Multiplexors (STDM) have become more popular over the last few years. STDM devices exploit the idle times inherent in interactive applications to allow the number of access devices to exceed the through-put of the trunk by a factor of three or four. By addressing each block with a control header, higher utilization is achieved by interleaving blocks for transmission which are reassembled by the destination STDM.

  - Care should be excercised where batch transmission is multiplexed since the header overhead can seriously degrade through-put of the batch application or intrude on response time sensitive interactive terminals, served by the same STDM.

7. INTELLIGENT TIME DIVISION MULTIPLEXING (ITDM)

- ITDM systems exploit microprocessor intelligence to exercise control of access terminals providing scheduling, and prioritization to eliminate the above mentioned problem with batch streams and to increase overall trunk through-put.

- Neither STDM nor ITDM have been implemented to any significant extent for voice communications. Since traditional voice digitization techniques produce 64kbps streams their integration into 9.6 or 19.2kbps data oriented multiplexors would be infeasible. It is likely that both of these multiplexing techniques will become popular for voice when vocoder technology becomes

cost effective at 2.4kbps rates. (Vocoders are discussed in greater detail at a later point.)

8. CONCENTRATION

- With the advent of low cost mini-computers, concentrators became popular usually for large scale networks (airline reservations sytems, etc.) Concentrators, in the days of FDM and TDM, offered the ability to allow access input to exceed the through-put level of the backbone trunk because of their ability to buffer traffic briefly to smooth out utilization curves.

- Concentrators typically perform control of the access network in terms of polling and selection of terminals, thereby reducing the central CPU loading and increasing trunk utilization by compressing concentrator/host dialogue to a batch-like format.

- Concentrators in the true sense have not been utilized for voice since traditional voice requires circuit switching to establish a continuous conversation path. The term concentrator is sometimes used in the telephone answering enviornment but these devices are really contention systems. True concentrators will appear when voice store and forward reaches maturity.

9. PACKET SWITCHING

- Perhaps the most sophisticated network organization available under todays technology is packet switched. At the current time this technology has been implemented exclusively for data communications networks.

  - Packet switching calls for the separations of bit streams into blocks, or packets which contain data as well as addressing information. Packet switched networks were initially developed by the Department of Defense's Advanced Research Projects Administration and lead to the implimentation of the Arpanet in 1969. Packet switched systems, in addition to providing speed, code and protocol conversion, were

desireable for defense applications where survivability considerations dictated distributed architecture with adaptive routing mechanisms. These systems are ideal for interactive low volume applications from widely dispersed local access users but the overheads induced by packet headers and other routing information (similar to statistical time division multiplexing discussed above) can cause severe degradation for through-put sensitive batch applications. Packet switched networks are implemented in two basic routing approaches; datagram and virtual circuit.

- Datagram systems, such as the Arpanet and Telenet, dynamically route traffic over alternate routes depending on backbone line saturation and availability. To accomplish this adaptive routing the control processors, or nodes, communicate their status with their nearest neighbors to update their routing algorithms.

- Virtual circuit networks usually do not support dynamic adaptive routing and by eliminating nodal algorithm updates can achieve somewhat greater backbone through-put, especially for batch type traffic. Alternate routing is, of course, possible for circuit outage. Tymnet is perhaps the most well known virtual circuit approach.

B. PROCESSING

- In the area of processing the improving price performance capabilities of mainframes, minicomputers and particularly LSI based microprocessors provides the greatest impetus to the digital revolution. The cost of microprocessors is dropping at a rate of 25% annually. While current microprocessor technology incorporates processors with 40 to 50 thousand circuit elements, it is anticipated that the number of elements will increase by a factor of 2.0 to 2.5 within the next 18 months providing further opportunities to exploit computer based processing power within the telecommunications environment.

- Typically the greatest advantage of digital processors for telecommunications is their ability to control, in real time, communications streams and hence provide greater utilization through a variety of compression tecniques. With the advent of low cost digital processing, time division multiplexing in its various forms becomes more cost effective. Most of todays sophisticated telecommunication system implementations rely to a large degree, on time division multiplexing, which should not be restricted to its narrowest implementations of traditional time division or statistical time division multiplexors.

- Time scheduling/multiplexing can be performed on two basic levels.

- On the micro level, pacing algorithms, such as those present in SNA and various other network architectures, allow higher transmission link utilization by applying digital processing technology to the analysis and control of bit streams at the link level. Pacing algorithms are in themselves highly complex. In fact, the algorithms will generally exhaust the ability of the analyst to fully exploit them before the capacity of the controlling processor is severly impacted.

- In the late 1960's experiments at the Department of Defense explored the ultimate in time division multiplexing; the technology of packet switching. Packet switching by packetizing data and allowing for non-sequential delivery of packets over a large number of alternate routes provided not only instataneous time division multiplexing on a single circuit, but in effect transformed the entire network into a virtual time division system.

  - Other hybrid approaches are being employed and will proliferate in the micro level compression schemes.

- An interesting hybrid digital control approach is the Bell System's implementation of common Control Interoffice Signaling (CCIS). This hybrid approach increases the connectivity of circuits throughout the Bell's Long Distance Network by providing a paralled data network which informs

nationwide switches of the availability of a connection from coast to coast. The CCIS technology avoids the traditional problems of straight circuit switching where a path could be established from coast to coast only to encounter a busy telephone at the end of the network.

- It is projected that the CCIS networking scheme will increase the capacity of the Bell System network by a factor of 10%. When we consider that the installed plant in the Bell System is valued at $39 billion, 10% capacity increase would equate to a cash value of $3.9 billion in construction that can be avoided.

• On the higher or macro level, the popular philosophy of distributed processing is another example of digital processing providing high levels of utilization via scheduling.

  - Relative to telecommunications implementations those transactions which can be serviced at a local site are obviously eliminated from communications streams.

• The motivation for distributed processing has been a highly controversial subject over the last five years or so.

  - In some cases distributed processing is mandated by surivability constraints such as in the defense environment.

  - In the commercial enviornment it has been implemented primarily to impact communications costs providing local autonomy to the end user for specialized applications or to use computer intelligence to enhance the man machine interface.

  - As microprocessor capabilities become more and more powerful, distributed data processing will become more and more a matter of routine. Earlier systems calling for large distributed minicomputers and concomitant large capital investments tended to provide

distributive processing with a glamor aspect which is now in the process of fading.

C. TRANSMISSION

- Digital intelligence has had dramatic effects in transmission systems for telecommunications.

1. BACKGROUND

- Telecommunications in its first electronic form was implemented via the telegraph in the 1840's. Interestingly the telegraph in its Morse Code format was inherently a digital service. The application of a current onto an open wire in either on or off conditions produced the familiar series of dots and dashes. This on/off system typifies telegraphy as a digital system.

- When telephone was introduced it was inherently analog, with good reason. The state of the art at that time would not support the complex processing required to translate the human voice into digital format.

  - One issue that must be constantly remembered is that the human voice, which is the most massively implemented telecommunications form is inherently analog.

- Simply stated it will be quite some time before human beings are able to generate digital signals. Despite limitations of analog signaling the common carriers have been successful in migrating from primative open wire systems to some very sophisticated high capacity frequency division systems. Under todays conditions, as we will see later in more detail, at least for long haul transmission digital has yet to approach the capacities of traditional analog systems.

- Digital telecommunications made its first appearance in the early 1960's with Bell's implementation of the T-1 Carrier. This system was developed to address the needs of short haul transmission in metropolitan areas. T-1 Carrier operates on twisted pair cable and provides 24 voice grade channels at 64 kilobits per second each over a 1.544bps communications facility. The T-1 termination equipment was also substantially cheaper than comparable analog frequency division techniques.

2. MEDIA

- At this point it would be appropriate to review the physical media employed in modern telecommunications. Those media, be they analog or digital, are separated into three primary areas:

  - Hard cable.

  - Microwave radio.

  - Satellite.

- Cable systems were first installed on open wire and moved later to twisted pair cables and finally into the high capacity coaxial cable. Over the years various techniques have been utilized to increase the capacity of a single cable with modified transmission modulation and multiplexing techniques. Cable is still the predominant form of communications and will continue to be at least for the early 1980's.

- One of the most exciting areas in todays telecommunications transmission environment is the implementation of fiberoptic cables. These fiberoptics technologies were implemented in the Chicago and Lake Placid areas on a trial basis. Bell has announced the construction of a fiber optic link between Cambridge, Massachusetts and Washington, D.C. which will provide the first intercity applications of this technology.

- The fiber optic system being installed by Bell utilizes physically pure strands of glass onto which digital light signals are applied. Each strand carries 672 channels at 44 MBP's and are grouped into tubes which are similar in dimension to traditional high capacity cables, and carry 144 strands. A single tube would carry some 100,000 channels with a bandwidth of 6.4 GBPS.

- Fiber optic transmission provides both extremely high bandwidth and very high quality transmission for voice and data.

- It is felt by some experts that the fiber optic technology will eclipse satellite transmission by the mid to late 1980's.

- An alternative to the sometimes difficult task of laying cable with right of way problems and occasional difficulties with hostile geography led to the implementation of microwave radio transmission. Microwave radio, once established, provides a reliable communications media which supports either analog or digital transmission. Some difficulties can be encountered with microwave radio transmission particularly in the higher frequency bands (11 GHz and 18 GHz). Price performance of digital technology allow these difficulties to be overcome as less expensive repeaters are available for installation minimizing the atmospheric noise problems which are primarily attributable to precipitation.

- Communication satellites were introduced in the early 1960's with the launching of Telstar. While satellite communications has been implemented on both analog and digital basis, it is anticipated that the major technological breakthroughs will occur in the digital low power transmission environment.

  - Satellite transmission has suffered from inherent problems particularly due to the costs of earth stations but more significantly to the propagation delay induced by beaming a signal some 23,000 miles into space.

- In voice communications, human dialogue can be severely disrupted by an overall 600 millisecond delay. Bell utilizes satellite transmission for only 2% of the connections established on the long distance network and these connection are half hop, utilizing a satellite in one direction and terrestrial facilities in the other. This lack of utilization and single hop reflect concerns for the quality of voice transmission by a satellite.

- Satellite transmission in the area of data communications suffers even more from the propagation problems which would add approximately 0.6 seconds to any interactive application and would severely impact the response time and through-put of batch systems where forward error correction techniques are not employed.

- A number of experts feel that satellite transmission is a transitional technology that will be justified for the wide deployment of video transmission for teleconferencing applications. Once a video transmission is established to a location, low quality voice and limited batch transmission could be integrated for economics of scale.

D. DIGITIZATION TECHNIQUES

- As mentioned earlier some difficulties are inherent in using digital communications. Certain inputs are inherently analog such as human speech, graphic communications, and video tranmission.

1. VOICE DIGITIZATION

- In the case of voice, the most popular digitization technique is Pulse Code Modulation (PCM). This technique utilies 64kbps streams to reproduce the human voice. This is accomplished in the following fashion.

- The human voice occupies a four kiloHertz spectrum. To accurately reflect this voice stream the signals must be sampled at twice the highest frequency or eight KHz. To in turn reflect these samples as digital signals, eight BITS are used to express the coded output. Simple multiplication shows us that we, therefore, derive a 64kbps channel (4,000 hz X 2 X 8 = 64KBPS).

- While this transmission rate presents no problems for a common carrier with dedicated physical plant where high speed modulation and multiplexing can be accomplished, it presents some difficulties for an end user to transmit these high speed signals over traditional narrow bandwidth networks.

• Various alternatives have been utilized to reduce this bandwidth. A variant on PCM, which is a quantitative technique, is differential pulse code modulation where a predictive compression allows bandwidth to be reduced to 40KBPS. Uncompressed black and white digital video occupies a bandwidth of 62.9 megabits per second.

- Utilizing commercial TV standards a single frame or picture is composed of a matrix of 512 X 512 picture elements. To provide full motion quality, 30 frames per second are required. The standard 256 levels of gray requires eight information bits. Simple multiplication again yields a total bandwidth of 62.9 megabits (512 X 512 X 30 X 8).

• Various compression techniques are being developed to reduce the inordinate amount of bandwidth for video transmission to levels compatible with more widely deployed facilities by using predictive coding methodologies and by applying digital processing intelligence to analyze the picture and send only those points which are changing. It is anticipated that reliable full motion video will be available at the 1.544 mbps T-1 carrier rate in the very near future.

2. IMPLEMENTATION OF DIGITAL TRANSMISSION

- The current implementation of digital and analog technology for long haul transmission favors the analog type of transmission system.

- While the L5 Carrier System represents a call carrying capacity of two and a half times that of the T4M, it should be noted that the T4M system is not exploiting anything other than straight time division multiplexing. The addition of statistical multiplexing could be expected to increase the capacity by at least a factor of four for the the T4M. (One vendor of vocoders and statistical multiplexers is claiming a compression ratio of eight to one.)

- A number of vendors including Rolm and Northern Telecom utilize a pulse coded, or digital, transmission technique. The PCM coding has a preliminary pulse amplitude modulated step at which point the outputs are coded by a device called a codec (coder/decoder) transformed into digital zero/one format.

- Bell utilizes a switching system called the #4ESS which is digital to provide high levels of connectivity at the high levels of the long distance network. The #4ESS has a call handling capacity of 550,000 calls in the busy hour and is being implemented in anticipation of direct switching of T family digital transmission carriers.

- Other digital systems are available from vendors such as Northern Telecom and Rolm for customer site installation. These switches employ techniques similar to the traditional T family pulse code mudulated schemes, but present some compatibility issues for network connection in that the Northern Telecom SL I utilizes a European T I standard and the Rolm systems use 10 bit encoding structures as opposed to the eight bit North American T I standard.

- In levels of functionality there is little significant difference between the pulse amplitude modulated switches and the pulse code modulated systems.

E. SWITCHING

- As the network is evolving towards digital transmission so will the switches composing that network. Telecommunications switches over the years were analog in nature. These switches were basically electro mechanical and provided a direct metallic connection between in and out circuits. These electro mechanical devices were termed space division switching systems.

- With the advent of digital control technology time division switching for both analog and digital voice transmissions became more widely deployed.

- Both the space and time divison switches employ stored program control capabilities of digital computers. The #1 ESS accounts for some 5,000 of the Bell Systems installed local central office. While it is electro mechanical and space division in nature, it employs a digital processor for control and connection supervision.

- During the current state of the art it is likely that the greatest benefit to the end user will be derived from stored program control capabilities of digital processors as opposed to esoteric implementations of digital switching matrices.

- Switches utilizing time division multiplexers are basically of two classes; analog and digital.

  - The analog switches utilize a technique termed Pulse Amplitude Modulation (PAM). This PAM technique samples the analog signals at high speed between 8,000 and 16,000 cycles per second. The instantaneous analog values of signal amplitude are then transmitted on a high speed bus in discrete time slots. Typical time division switches superimpose 64 voice conversations onto 64 time slots with the signal sampled at 16,000 per second. The total band width of the bus then is 1.024 megaherz per second (64 X 16,000). This PAM technique will be

adequate for most of today's applications as well as initial ventures into office automation.

- Digital switches usually perform a preliminary PAM step after which the sampled output is translated into digital (0+1) format by a device termed a Codec (coder - decoder). Digital outputs are than switched over high speed full duplex (or 4 wire) busses.

F. PBX

- PBX's have reflected three generations from the standpoint of functionality:

  - Manual.

  - Dial.

  - Integrated.

1. MANUAL SWITCHBOARDS

- In its earliest days the entire network was composed of operator manned jack and plug switchboards. Business customers utilized similar PBX's where operators would switch incoming trunk calls to internal telephone users. Outgoing and intra-office calls were handled in a similar manual fashion.

2. DIAL PBXs

- The carriers recognized the labor sensitivity of this manual arrangement and ultimately began a migration to automatic dial systems for the network. Similar systems were made available for customer site installation in the 1920's. These "dial" PBXs as they were termed eliminated operator handling of outgoing and intra-office calls.

- Systems introduced in the 1960's allowed the telephone user to transfer and conference calls with switch hook button manipulation. Direct inward dialing, available first with the central office based Centrex service, eliminated operator handling of incoming calls. Additional features have been included to make the user more autonomous and to replace the switchboard operator.

- The technology available to accomplish the replacement of the operator until the mid 1970's was primarily hard wired and primitive. The introduction of sofware based systems from vendors such as Bell, Northern Telecom and others provided more effective user autonomy. While these systems were limited at first to simple operator replacement functions such as multiple ring tones, call forward and no answer transfer, more advanced features are appearing every day.

- The clearest example of operator replacement with user intervention is to be found in automatic route selection and queueing capabilities.

- In the older electromechanical systems the operator could effectively route calls over special facilities such as WAT's or foreign exchange. The operator would know who was entitled to lines in general and which executive would get special treatment. When the operator was removed and stored program control was unavailable or restricted, users were commonly treated as restricted or unrestricted, giving the users too much or too little service entitlement.

- Stored program control PBX's provide major advantages. These systems allow the user to make changes and rearrangements himself via program changes. Complex traffic routing, queuing and restriction routines can optimize network usage without placing undue inconvenience on the telephone user. Network usage statistics can be collected and analysed for abuse control, departmental billing and network engineering.

- Stored program control allowed multidimensional user entitlement tables to be used with a computer making the decision for the proper facility based on user

priority. Since flexible levels of restriction were available each user could receive the level of service to which he was entitled.

- As stored program control increases in its complexity voice terminals will be advanced to avoid the traditional switch hook signaling. As such human engineering requirements are implemented the telephone will begin to look more like a data terminal.

3. INTEGRATED PBXs

- The next generation of integrated customer switching systems will provide all of the traditional PBX features but will be different in several important aspects.

- These new controllers will, of course, be digital, but will have orders of magnitude more capacity than second generation digital PBXs. As the controller becomes the hub of the automated office, handling voice, data, image and possibly video, more powerful control processors will be required for supervision and switching.

  - Significant processing resources will also be required to provide advanced user/system interfaces.

  - Higher bandwidth applications integrated through the switch will require higher capability time slots of 128 kbp as opposed to todays 64 kbp digital PBXs.

- To optimize performance, installation and maintainability, the systems architecture will be distributed hierarchically. A central minicomputer processor and switch will service distributed micro processor based controllers via high speed fiber optic or coaxial cable buses.

- The codec, or analog/digital converter, will be moved from the central or distributed controller modules to the telephone terminal.

- An Exxon enterprises subsidiary, Intecom, was the first to announce a third generation controller in May of this year. However, as of this writing none of these systems have been implemented out of the laboratory.

- An indication of the voice/data integration trend will be evidenced by the entry of information processing vendors into the PBX business. IBM, already a vendor of switches in Europe, (IBM 3750, 1750) is expected to enter the domestic market within the next year or so. There are indications that others such as Datapoint and Burroughs will follow suit. Major interconnect vendors such as Rolm and Northern Telecom will, of course, appear with new high capacity integrated systems.

APPENDIX C: THE ROLE OF STANDARDS

APPENDIX C: THE ROLE OF STANDARDS

- This appendix will discuss the role of standards in determining which services will be available to users, which products vendors will be offering and how much it will cost to use those services and products.

A. STANDARDS AND STANDARDS MAKING

- Standards are agreed upon methods of building or operating a system. The key words are "agreed upon." Standards are no longer as simple as a length or a weight that could be set by royal fiat. Today, standards are as complex as the systems they describe. They are spelled out in lengthy documents developed at large cost.

- Standards are developed by a complex set or organizations. These include governments, international organizations, industry associations, individual vendors and users. (See Exhibit C-1.)

- In the communications area, users or user organizations are not nearly as active as they are in such areas as computer languages.

EXHIBIT C-1

STANDARDS MAKING ORGANIZATIONS

ORGANIZATION	MEMBERSHIP	COMMENTS
ITU - INTERNATIONAL TELECOMMUNICATIONS UNION	154 NATIONS USUALLY REPRESENTED BY THE GOVERNMENT COMMUNICATIONS ORGANIZATION	• U.S. IS REPRESENTED U.S. STATE DEPARTMENT (OFFICE OF INTERNATIONAL COMMUNICATIONS POLICY) • TWO STANDING COMMITTEE ARE CCITT AND SIMILAR COMMITTEE/OR RADIO ISSUES
CCITT - CONSULTIVE COMMITTEE ON INTERNATIONAL TELEPHONE AND TELEGRAPH	SAME AS ITU BUT WORK IS DONE BY STUDY GROUPS (SG) OF WHICH THERE ARE 18	• FUNCTION IS TO MAKE RECOMMENDATIONS TO ITU • SG VII CONCERNED WITH PUBLIC DATA NETWORKS (X.25) • SG XVII DATA TRANSMISSION (V SERIES MODEMS ETC.)
NATIONAL ORGANIZATION FOR THE CCITT	INTERESTED AMERICAN COMPANIES OR INDIVIDUALS	• COMPRISED OF A STEERING COMMITTEE AND 4 STUDY GROUPS • SG 4 RESPONSIBLE FOR DATA TRANSMISSION • OTHER SG'S FOR TARIFFS, TELEGRAPH AND INTERNATIONAL TELEPHONE

EXHIBIT C-1 (CONT.)

STANDARDS MAKING ORGANIZATIONS

ORGANIZATION	MEMBERSHIP	COMMENTS
ISO - INTERNATIONAL STANDARDS ORGANIZATIONS	APPROX. 90 COUNTRIES, EACH REPRESENTED BY ONLY ONE AGENCY. "OBSERVERS" WORK BUT NOT VOTE.	• ORGANIZED INTO TECHNICAL COMMITTEES (TC), SUB-COMMITTEES (SC), AND WORKING GROUPS • TC97 COVERS COMPUTERS AND INFO PROCESSING • TC97/SC6 IS FOR DATA COMMUNICATIONS EXCEPT FOR • TC97/SC16 FOR OPER. SYSTEMS INTERCONNECTION
ANSI - AMERICAN NATIONAL STANDARDS INSTITUTE (NOT GOVERNMENT AFFILIATED)	OVER 1000 TRADE ASSOCIATIONS AND COMPANIES ARE SPONSORING MEMBERS	• OVER 300 STANDARD COMMITTEES • COMMITTEE X3 FOR COMPUTERS AND INFO PROCESSING • X3 HAS OVER 20 TECHNICAL (SUB) COMMITTEES • X3S3 IS FOR DATA COMMUNICATIONS • S3T5 IS FOR OPER SYSTEM INTERCONNECTION
EIA - ELECTRONIC INDUSTRIES ASSOCIATION	A NATIONAL TRADE ASSOCIATION	• ENGINEERING DEPARTMENT HAS OVER 200 COMMITTEES • TR-30 (TECHNICAL COMM.) IS FOR DATA TRANSMISSION • TR-30.2 IS FOR DIGITAL INTERFACES (RS-232,ETC.)

EXHIBIT C-1 (CONT.)

STANDARDS MAKING ORGANIZATIONS

ORGANIZATION	MEMBERSHIP	COMMENTS
NBS - NATIONAL BUREAU OF STANDARDS	U S GOVERNMENT AGENCY	• ENGINEERING LABORATORIES IN BOULDER • WORKS CLOSELY WITH NTIA, NATIONAL TELECOMMUNICATIONS AND INFORMATION AGENCY, A POLICY BODY.
FTSC - FEDERAL TELECOMMUNICATIONS STANDARDS COMMITTEE	U S GOVERNMENT AGENCY	• A COORDINATOR OF FEDERAL PARTICIPATION AS A USER OF COMMUNICATIONS SERVICES. • PART OF THE NATIONAL COMMUNICATIONS SYSTEM.

- The main reasons appear to be expertise, time and money. Few users have more communications expertise in house than is necessary to maintain current systems and implement the next application, often with vendor assistance.

- User technical personnel usually concentrate on immediate problems and short range development. A five year plan may reference X.25 or local networks, but the time to learn them in detail is when the user starts to evaluate product.

- Money is a major consideration for most users. Having "excess" technical personnel with time to particpate in standards development is expensive, as is the travel to frequent standards committee meetings.

I. STANDARDS ORGANIZATIONS

- Communications standards have been developed for decades by what is now the ITU and CCITT. In the U.S., the EIA has worked closely, through the National Organization for the CCITT SG4, with CCITT to assure that U.S. interface standards agreed with international ones. Therefore, RS232C has its international counterpart, CCITT V.24/V.28.

- Standards for computers and information processing and exchange were first developed around 1960. The first standards were for programming languages but now include most areas of data exchange and equipment interconnection. ANSI and ISO are the major orgnaizations involved with these standards.

- The ANSI committee, concerned with information processing, is designated X3. It was established in 1960. X3 is composed of producers or vendors, consumers or users and general interest (academic institutions, professional organizations and occasionally individuals).

- None of the three groups is allowed to have a majority when X3 votes on standards proposed by the technical committees.

- Fortunately, there is cooperation among the two sets of organizations. ISO/TC97 subcommittee 6 (for data communications) members have a regular liaison arrangement with the CCITT study groups concerned with similar areas.

- In the U.S., ANSI's subcommittee for data communications X3S3 holds regular joint meetings with its EIA counterpart TR-30.

- In many instances, the same individuals serve in both organizations greatly aiding liaison and helping to eliminate confusion and misunderstanding.

- The U.S. government is also deeply involved with standards, primarily becuase it is the largest user of computers and data communications in the world. The National Bureau of Standards (NBS) is charged, under law, with setting standards for government procurement. While NBS works with ANSI and EIA, it is able to go its own way and/or work at its own pace. Having NBS participation on an ANSI committee does not guarantee that the federal required standard is what the vendor or user communities want.

- Another goverment agency, the Federal Telecommunications Standards Committee (FTSC), is part of the National Communication System (NCS). FTSC works closely with NBS in the data communications area and also works closely with EIA and CCITT, helping to assure consistency.

- A last organization that has a direct bearing is the IEEE Computer Society. This group within the Institue of Electrical and Electronic Engineers professional society has become involved with standards for microcomputers and ways to interconnect them. Therefore, they are developing their own standards for local networks that may influence future products from many vendors.

2. THE STANDARD SETTING PROCESS

- All of these organizations appear to function in much the same manner. The major international organizations hold plenary meetings at lengthy intervals for voting on standards. The committees meet every few months to work out the recommendations for the plenary sessions. The national committees meet monthly or quarterly to develop their own recommendations for the international committees.

- All of this take much time and effort. Having so many participants and so many meeting is cumbersome and expensive, but does assure thoroughness. Important items that are excluded from a recommendation are usually done so intentionally to let someone else raise the issue or to force attention to most significant issues.

- As the issues in data communications standards increasingly effect both the computer and the telecommunications vendors, lobbying for which side will control an issue can be expected to grow. Control is not just what is in the final standard, but, just as much, in when a committee will make a recommendation or a vote will be taken.

B. KEY AREAS FOR STANDARDS IN COMMUNICATIONS TODAY

- While there are literally hundreds of standards or sections of standards being developed, here we will discuss only major topics and key issues relating to them.

I. OPEN SYSTEM INTERCONNECTION

- Probably the most important topic now in the standards world is <u>Open System Inteconnection (OSI)</u>. It is important because it is so all encompassing. The purpose of OSI is to allow any two computers, terminals or "processes" to exchange information according to an agreed upon set of rules or protocols.

- OSI is not just for data. It would work equally well for text, facsimile or even voice. It will work with or without encryption.

- With the increasingly rapid spread of computers, word processors, facsimile machines and telephones, users are being burdened with systems that cannot work with each other and with miles of partially used wire. OSI will provide a method for communicating.

- Vendors will either continue developing their own proprietary methods for interconnecting or agree to conform to the OSI model. As OSI becomes accepted, users will begin to expect demand that vendors conform to the OSI model.

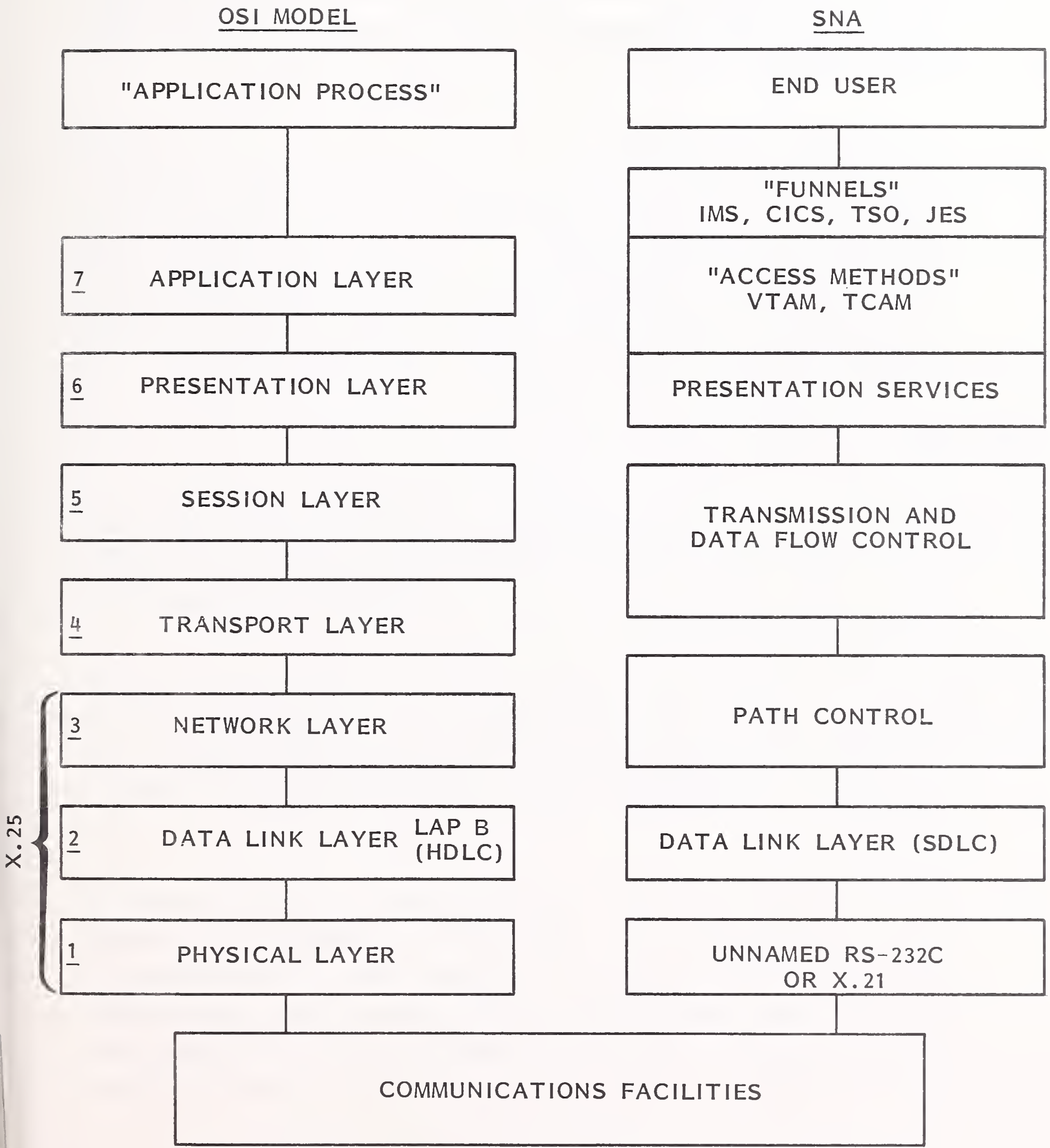
- The major threat to OSI is from computer manufacturers' own methods for interconnections, such as IBM's SNA or Digital's DECNET.

- OSI and SNA both are layered architectures as shown in Exhibit C-2. But so far, IBM has kept most functions in the host access methods, VTAM or TCAM. In fact, the way current versions of SNA are implemented, the access method includes the presentation, transmission and data flow control as well as the critical portions of path control. The result is that the layers may represent demarcations within the access method code but are not useful for defining user recognizable access points to the communications system.

- IBM is now suggesting to standards making organizations that SNA be used as a model or guide for developing the application layer of OSI. IBM suggests that since SNA is already working, it would save time and effort to use it.

EXHIBIT C-2

OSI VERSUS SNA LAYERING SCHEMES



Certainly time and effort for IBM if it does not later have to convert its software to the OSI model.

- The first version of the OSI model is expected to be approved at the plenary session of ISO/TC97/SC16 in Berlin in November 1980. It is expected that the model will be refined and extended over the next few years. It is not intended to remain static.

- In this regard, it is interesting to note that the U.S. position is that the OSI specification is a "reference model" for comparison to other standards or specific implementations. Europeans, on the other hand, are already pushing for the OSI model to be a "standard." In this regard, the transport layer, where the application related layers 5, 6 and 7 meet the transmission system as presently being described by ISO/TC97/SC16 is being considered as a CCITT standard.

2. X.25

- A second major area of standards work is the packet network description known as X.25. This standard was rushed to completion for the 1976 CCITT plenary session. At the time it was far from complete. A much revised and improved standard is scheduled to be approved at the plenary this fall.

- At this point, note that the X.25 standard is a CCITT function while OSI is in ISO's realm. Also, the OSI model is concentrating on layers 4, 5, 6 and 7; X.25 is the designated standard for layers 1, 2 and 3. Note, also, that there is already some agreement between ISO and CCITT about layer 4.

- X.25 is being used as the basis for developing public networks in a number of countries, including the U.S. While AT&T has withdrawn its Advance Communication Service (ACS), it is significant that AT&T has chosen to develop an internal network based on X.25. Known as BX.25 within the Bell System, the network is described as a layered implementation including the transport and session layers. Documentation of BX.25 is intended for potential

suppliers to AT&T and states that revisions may be made to maintain conformance with ANSI, ISO, EIA, CCITT standards, or advances in the state of technical arts.

- Several manufacturers of computer and communications systems have chosen X.25 as a basis for network development. With so much X.25 network development, it is reasonable to assume that X.25 capability will be offered by most computer manufacturers by 1985.

- Even IBM offers X.25 gateways to SNA, but they do it for now in France and Canada in a very awkward manner. Rather than substituting X.25 for SNA path control and data link control, the wrap the SNA packet inside an X.25 packet, making for double work at these layers and more packets.

- The reason that IBM is supporting X.25 at all--and may be forced to do so more in the future--is that the private lines that SNA is designed to use may not be available in the future in many countries. Even AT&T may be moving away from private lines to emphasis on an update MTS system and an X.25 compatible data network. In that case, SNA, as now implemented, would not be possible to anyone other than SBS users, or users of other satellite or microwave carriers.

- As leased line services are increased in cost and decreased in availability throughout the world, public packet networks, with the X.25 interface will become the only viable method for implementing a nationwide or worldwide data network without large scale satellite facilities.

3. X.21

- The physical interface between computer/terminal equipment and communications equipment that is most used in the U.S. and throughout the world is RS-232C. This 20 year old standard is in need of replacement or revision. It is limited in the speeds it can handle, the allowable distance between the business machine and the modem and range of its functions. Also, there are several incompatible implementations of this interface.

- The long term solution that is proposed is the X.21 interface, which will allow for high speeds, long cable lengths and a range of control functions impossible with RS-232C.

- X.21, which is the physical interface specified for level I in X.25, is an "intelligent" interface. The connection uses fewer wires and pins than RS232C. Rather than multiple control leads, there is one going to the modem and one going back to the terminal equipment. Codes are used to specify the control functions.

- X.21 is desirable--but converting to it en masse would be expensive. Modems and equipment interfaces would need to be exchanged in a coordinated manner for each end of a circuit.

- Therefore, an intermediate step has been arranged, RS-449. This interface in a modem can provide many of the new functions of the X.21 interface while working with RS-232C equipped terminal equipment. This can be accomplished by changing the plug on the cable or by using an adapter unit. The key point is that no expensive changes will be required in the terminal equipment.

- It is now expected that the evolution to X.21 will require changing the interface logic in the terminal equipment. IBM has already indicated that they plan to supply X.21 interfaces for their products, just as they supply the seldom used DDS now.

- With the growing emphasis on network control and diagnostic capabilities, it is logical to consider using the new interfaces as soon as they are generally available. Rather than having a proliferation of smart modems that only work with the manufacturers network control system, a standardized set of control functions, such as loopback testing, will allow for more flexibility in network development.

4. LOCAL NETWORKS

- Local networks provide one of the greatest opportunities to achieve greater productivity in the office without corespondingly larger costs. The productivity increase will come from the ability to use a wide variety of equipment as required and have it interconnect on a common network. The cost savings will come from not having to string new wire from a central switch or controller each time new equipment is added.

- The key issue with local networks is whether there will be few standards or many. A single standard, used by all, is very unlikely.

- Ethernet, develop by Xerox, is certainly the most well known at this time. The Xerox arrangement with DEC and Intel provides a method of getting many Ethernet users who would not necessarily use Xerox office equipment--but could, very easily, once Ethernet is used in an installation. DEC will provide the gateway to larger computer systems, using DECNET with both X.25 and SNA interfaces. Intel will provide the chip sets (initially, printed circuit boards) for other vendors to use in building products that can use Ethernet.

- There are a large number of competing local networks. Many are one of a kind within a company or university. A few are intended for the marketplace as Ethernet competitors. These include Ungermann-Bass' Net/One, Zilog's Z-Net. Also, there are local nets based on broadband cable television technology from such companies as 3M/Interactive Systems and Sytek/Network Resources.

- But the real battle that is to come in the local network area, is between AT&T and IBM. Both have huge investment in existing products or plant and cannot easily convert to new technology. Each understands the importance of controlling communications within customer organization. Neither is likely to cooperate in development of a major standard that, if adopted, would work against its strong market position.

- AT&T is wedded to PABX type operations, each peice of equipment connected by a twisted pair to a central switch. Data can be added to the switch's capabilities, but you still have a dedicated circuit from each device back to the switch.

- AT&T and other PABX vendors will develop local networks around their switches and can be expected to expand their product lines to include other office products--all without Ethernet interfaces.

- IBM has a variety of "local network" architectures: star/coax for the 3270, loop/twisted pair for the 8100 and a loop for the financial terminals. Each has been developed over a number of years and apparently without much coordination. Also, IBM is a major PABX manufacturer in Europe and is rumored to be readying a new digital PABX for the U.S.

- IBM is <u>slowly</u> moving to the use of SNA as its own standard for interconnecting all devices in a network. IBM's problem is to develop its own unifying local network without obsoleting its and its customers investment in existing products and applications to support those products. Whether it will be a coax base star, ring or "ether" or twisted pair--or a combination--is yet to be determined.

- What ever direction IBM takes, it will more likely be determined by its own marketing and product plans than by an industry standard assuming a standard could be developed in a reasonable time period.

- So the local network standard arena is full of gladiators. With such a large market/arena all we may see for several years is warm up exercises and attempts to form teams. Battles, if they ever occur, are several seasons away.

5. PBX

- The PABX market is another one that is receiving a lot of attention as a possible switch for data as well as voice. But so far, digitizing the working of the switch has not changed the basic analog working of the telephones. Digital encoding is still done in the switch because the cost of coding chips (CODECS) has not come down enough to put them into each telephone.

- Data ports for low speed terminals rely on digital input, so the new PABX's actually handle both analog and digital input.

- As the number of analog phones increases, it becomes less likely that there will be a rapid conversion to digital telephones just because the CODEC's are inexpensive even though the twisted pair can usually handle the currently used 64K b/s for digitally coded voice.

- There is no known work to allow IBM 3270 coax at 1 Mb/s or other such networks to operate through a PABX. So unless IBM achieves a unifying network scheme, it would appear that PABX's will be primarily for voice and low speed terminals. It is not likely that PABX's will provide a control/-switching point for a total voice/data network within an office.

- There has also been some concern about the incompatibility of the telephone systems into which PABX's must tie in. The digitizing schemes used in the U.S. and Canada is different from that used in Europe. The PABX manufacturers simply use different interface modules in their units and claim to have no problems.

- Likewise, the PABX manufacturers are not troubled by the incompatibility between differences in carrier's trunk bandwidth. In the U.S., TI carrier carries 24 digital circuits plus control signals at 1.544 Mb/s. Europeans use 2.048 Mb/s which yield 32 circuits of which one is for control. Some PABX manufacturers supply the "channel banks" that connect to the carrier. Others buy then from OEM suppliers if they are needed. Since circuits like TI are not tariffed by Bell, it is really just 24 going into the channel bank that the PABX itself is concerned with.

- So, the PABX, while highly visible and bound to carry increasingly more data along with voice, is not directly involved in standards issues. But any direction the PABX Manufacturers move puts them into areas where proposed standards influence opportunities.

6. STANDARDS FOR HOME SYSTEMS

- The last area to be mentioned is standard for home systems.

- The most visible and with the most commercial potential are the teletext and viewdata type systems. Each is designed to use existing television sets for retreiving data from data banks, catalogs, news bureaus, etc.

- While there is some proposed compatibility between the systems, they differ tremendously in how the data is transmitted and who controls (derives revenue from) the service.

- Teletext data is carried by the television broadcasters or cable television companies. A standard is being developed by EIA for this system.

- Viewdata uses telephone lines to deliver the data to the television adapter. It should come as no surprise that AT&T is participating in a test of such a system in the U.S.

- Both types of service originated in the U.K. and there are already variations in other countries besides the U.S. Just as with television signals, international standards are unlikely for either services.

- The U.S., with its competitive communications and broadcasting industries, will take time to settle on a standard, but the broadcasters will undoubtedly have a standard for Teletext first; they know they must beat AT&T and the telephone system to the market before AT&T has an unregulated home business services unit.

C. TRENDS IN STANDARDS AND STANDARD MAKING

- The first to market or the largest competitor can still create "de facto" standards. Increasingly, however, we are seeing users and other vendors question such "standards."

- The trend is to work towards an industry standard. Admittedly, the standards making operation is controlled to some extent by the largest vendors and/or users. IBM wants parts of SNA used as a model for OSI. AT&T backs X.25 development as it raises charges to private line users, but there is recognition that a standard will be achieved, without them, if necessary, so they cannot delay forever.

- Standards are beginning to move out of the one-at-a-time realm into the systems area. X.25 incorporates link and physical interface levels. OSI incorporates X.25. Local networks are being studied for conformance with OSI.

- Standards development work is being pushed at a rapid pace in many areas. Meetings are held more frequently. People are assigned full time to standards development. Electronic mail is being used to speed delivery of documents for review and the return of comments.

- It is not reasonable to expect standards before first products appear in a market. They would be error prone and incomplete, but where standards are practical and desired, the standard making machinery can be accelerated. Since the standard may not be desired by all, this trend may not be entirely beneficial for the user community or the myrial of small vendors.

- There is also a movement in some areas to get the court system and the government bureaucracy involved in the standard making process. It is not clear what would happen if an independent orgainzation such as EIA or ANSI adopted a standard and then was used by a small vendor claiming his idea or product was excluded from the standard by large vested interests.

- One implication of all the effort in standard making is that standards are becoming big business. There is a booming business in books and seminars by experts on particular standards. As often as not, it is government employees or consultants to the government who have been working on the particular standards who give the seminars.

- Even a report, such as this, on market opportunities, must include an appendix on standards since they do influence markets and market growth.

D. FUTURE EXPECTATIONS INFLUENCED BY COMMUNICATIONS STANDARDS

- De facto standards will continue to be a major influence on the communications market. SNA and Ethernet will not go away because some other model becomes a standard.

- Because communications systems are increasingly software intensive rather than hardware, they can be expected to both proliferate in numbers and evolve in capabilities. Users will push for more standardization but non-standard products, using ever newer technology, will always be tempting. The good of OSI is to have a model for new products to conform to--but OSI itself will evolve.

- What is envisioned for the future is a variety of communications systems being used by each user organizations. Standard system may provide backbone functions with new systems being tried first only in local area.

- SNA, X.25 nets, DECNET, etc. might be used for linking computers and/or terminals between sites. A broadband coax systems would be used between major organizations at a site, and Ethernet or another baseband coax system handling terminals, wordprocessors and fax equipment in a small building or one or two floors of a big one.

- Despite much work by Xerox and others, there appears to be no way to compress voice in a practical manner in the short term. So telephone systems will continue and will compete with the Ethernet sized networks for terminal and text transmissions. It is not just lack of standards that is causing the competition. It is a combination of evolving technologies that cannot easily do the whole job now and the reluctance of the data processing and the communications forces to relinquish any turf to the other side.

- The first version of the OSI reference model will be approved in November and there will be ongoing effort to improve and extent it. AT&T can be expected to support it since carriers will benefit if more systems can be easily interconnected.

- IBM and other large mainframe companies can be expected to drag their feet but eventually make their private network architectures compatible at one or more levels. Do not expect this in the next three years.

- In communications, many people have gone through a number of phases: initial learning what it is all about, implementing first networks, expanding those networks into new applications and technology. Because there is so much standards activity, we are in a phase when many people are now concentrating on standards in order to better plan their future activities. It could be that in just a few years standards will be taken for granted and the emphasis will be swung around to increasing productivity through improved applications and user friendly products.

- What is envisioned for the future is a variety of communications systems being used by each user organizations. Standard system may provide backbone functions with new systems being tried first only in local area.

- SNA, X.25 nets, DECNET, etc. might be used for linking computers and/or terminals between sites. A broadband coax systems would be used between major organizations at a site, and Ethernet or another baseband coax system handling terminals, wordprocessors and fax equipment in a small building or one or two floors of a big one.

- Despite much work by Xerox and others, there appears to be no way to compress voice in a practical manner in the short term. So telephone systems will continue and will compete with the Ethernet sized networks for terminal and text transmissions. It is not just lack of standards that is causing the competition. It is a combination of evolving technologies that cannot easily do the whole job now and the reluctance of the data processing and the communications forces to relinquish any turf to the other side.

- The first version of the OSI reference model will be approved in November and there will be ongoing effort to improve and extent it. AT&T can be expected to support it since carriers will benefit if more systems can be easily interconnected.

- IBM and other large mainframe companies can be expected to drag their feet but eventually make their private network architectures compatible at one or more levels. Do not expect this in the next three years.

- In communications, many people have gone through a number of phases: initial learning what it is all about, implementing first networks, expanding those networks into new applications and technology. Because there is so much standards activity, we are in a phase when many people are now concentrating on standards in order to better plan their future activities. It could be that in just a few years standards will be taken for granted and the emphasis will be swung around to increasing productivity through improved applications and user friendly products.

- The users expectation is for equipment as easily interconnected as lights are connected to an electrical outlet. Can this be done? Yes. Will it be done with a single "standard" method? No.

E. IMPLICATIONS

1. IMPLICATIONS FOR VENDORS

- For vendors of communications and equipment, the current standards situations is good for business.

  - Modems using RS-232C will continue to have a market while the newer more intelligent units will raise average prices.

  - Communications processors other than standalone message switches, will grow as more networks are built and particularly as more smaller nets are interconnected. Communications processors serving as gateways between dissimilar networks will see rapid growth, but the cost to market will be high because it will be difficult to reach and support all the possible combinations.

  - Local network vendors will have tremendous growth, again because of need rather than standardization. Standardization will be good for the semi-conductor manufacturer.

  - PABX vendors will increase unit revenue by adding data handling features, but the real market accelerator will be adding office products that communicate through the PABX. This includes AT&T.

  - AT&T has much to gain through standardization. From a carrier point of view, anything that makes it easier to communicate is good for AT&T. That includes SNA and DECNET and even Ethernet. Anything

to get more data flowing over the lines. AT&T will tolerate MCI, SPCC and Amsat, much as IBM tolerates Honeywell, Univac or STC. They don't like them but it is more important to concentrate on doing their own job well than worrying about small competitors, who will grow along with them.

- For vendors of connected equipment, standards for interconnection will be good for most vendors.

  - Easy interconnectivity will allow users to rapidly grow the use of terminals for electronic mail and other applications. Whether standards are "official" or "de facto" does not matter. CRT's, printers, disc drives and the node processors to which they attach can all expect good growth.

- Conforming to a standard such as OSI or Ethernet (which may eventually be shown to conform to parts of OSI itself) would mean that competitors equipment could easily be used in an environment that was formerly all one vendor. The product emphasis will be on features/price/performance just as it is in the plug compatible disc or terminal market. There will be room for many competitors in the systems business, but some companies that do not provide good product, service or price may be eliminated.

  - IBM is in a curious position. It uses a wide variety of technologies to interconnect its products. Certainly it is not their intention to have only one easily copied interface. SNA will continue to evolve into a complex networking system, but more and more vendors will attach to it by describing their systems to SNA as cluster controllers. For SBS customers, IBM will be protected, but, otherwise, AT&T will continue to whitle away at the availability of private lines while slowly raising rates to match costs.

- Because of IBM's large customer base, it would seem that they could not do anything revolutionary--they must support all the terminal to processor interfaces as well as SNA into the indefinite future. But...

2. IMPLICATIONS FOR USERS

- Despite all the interest in and discussion of standards in the past few years, there are only a few standards in existence or development that will have short range impact on communications systems.

  - Modems will evolve to RS-449 internal working without necessity of exchanging existing equipment with RS-232C interfaces. When new terminal equipment with optional RS-449 or even X.21 interfaces becomes available, users will gradually switch. User intent to upgrade will be controlled by availability of the new products.

  - As a network interface, X.25 will be offered by an increasing number of system vendors. Outside the U.S., this is of major importance. In the U.S., with only Telenet offering an X.25 network interface, use of X.25 will grow more slowly than vendor network architectures. This would change quickly if AT&T could ever get ACS into operation.

  - It is not likely that any local network architecture, officially standardized or not, will receive widespread implementation until 1983 at the earliest. Intel will not have Ethernet interface chip sets until 1982.

  - Existing PABX/telephone design using twisted pairs of wire is not going to be replaced by any of the existing vendors. They will extend that technology to the handling of terminals but that is only an adaptation of what is already being done.

- In short, users must get on with the business of increasing productivity by using products in the market today. There is no standard that will obsolete existing products in their useful lifetime.

- Vendor selection based on engineering capability, commitment to product line evolution and the resources to keep going (rather than just on price/performance of today's products) will be increasingly important.

- Just as modem interfaces will evolve, so will network interfaces, and there will always be a market for "black bores"--adaptors that can provide a gateway between incompatible systems. This is one market that seems to grow despite the efforts of vendors to keep up with market needs.

- In the long run, the OSI model will have a significant effect on product offerings and user communications oriented systems, but compliance with the OSI model will be gradual piecemeal. Software products will evolve. Users could shorten the timeperiod until vendors X's equipment works with vendors Y's equipment because they both comply with the OSI model by leaning towards vendors who are committed to compliance. The vendors must have reasonable plans to get to the future OSI compatible product from where they are today, complete with dates for intermediate steps.

- Users should also be encouraged to have a direct effect on standards by getting involved with the standards committees on a larger scale. The ANSI committee working on the OSI reference model is composed primarily of vendors and consultants to the federal government. The only major user involved is the government itself. Why not save money on seminars and books about standards and get more people involved in making standards. Learn first hand what next year's seminars will be about. Why shouldn't a user make presentaitons on standards to his own company or a user organization as well as a vendor representative could.

APPENDIX D: CHANGES IN THE REGULATORY ENVIRONMENT

APPENDIX D: CHANGES IN THE REGULATORY ENVIRONMENT

A. INTRODUCTION

- Government regulation of the communications industry is important to users and suppliers of communications services for these reasons:

  - Regulation determines who can market services and the characteristics of the services that are offered.

  - Regulation governs the prices that a supplier can establish for its own services and prices of the services with which it must compete.

  - Regulation can delay the introduction of services and postpone the effectiveness of changes in their prices, the terms under which they are provided, and their characteristics.

  - Regulation controls the relationship among suppliers such as the extent to which the services and facilities of other carriers can be employed in one's own services.

- Most of the discussion in this Appendix focuses upon AT&T and the FCC because they are the dominant forces in the industry.

- Regulation of the communications industry at the federal level has passed through two distinct phases and is entering a third:

  - The period through the mid-1960's in which the FCC focused upon controlling AT&T's prices through informal means, as opposed to traditional methods of public utility regulation. The FCC had almost no effect upon industry structure. It may have influenced the price of service; but primary credit must be given to AT&T's farsighted business policy of providing high quality, universal service at affordable rates.

  - The period from the early 1960's through the present, has been characterized by a formal ineffective adversarial regulatory process and upon the FCC's ad hoc policy of introducing competition into selective service areas. Communication quality has remained high. The FCC's attempts at controlling events have often been frustrated, particularly regarding two important services, Telpak and WATS, although some of its efforts may now be coming to fruition.

  - The period that is now beginning in which, as a matter of overall policy, competition will be relied upon in those markets where competition is appropriate and traditional regulatory concepts will be used in controlling the provision of basic services by dominant carriers.

- Concepts of public utility regulation and the sources of the FCC's powers are briefly described in this Appendix. Trends in the pricing of communications services and developments affecting industry structure are discussed. The probable impact of pricing trends and the form of regulation upon users and suppliers is also discussed.

B. THE CIRCUMSTANCES THAT LEAD TO ADVERSARIAL REGULATION

1. THE "OVER 890" DECISION

- The modern era of regulation began in 1959 as a result of the adoption of a new technology, microwave, to commercial use. Microwave systems had become common among right-of-way companies and governmental organizations by 1956, although interconnection with the public network was not permitted. At that time, the Commission began an inquiry as to the supply of microwave frequencies, which led it to allocate frequencies above 890 megacycles for these private systems in 1959.

- AT&T's reaction was to offer three new forms of service, WATS, Telpak, and WADS, to counter what it apparently perceived as a threat of loss of revenue to private systems and to Western Union, which had begun constructing its own network.

2. DESCRIPTION OF WATS, TELPAK AND WADS

- The important characteristics of these three services were as follows:

  - WATS, Wide Area Telephone Service, provided unlimited interstate telephone calling within specified areas for a flat monthly rate at a discount of the order of 50% in typical heavy business use.

  - Telpak was a term applied to a schedule under which transmission lines could be leased by a customer. As originally filed, Telpak was similar to private microwave systems in that the circuits leased followed specific routes; but the tariff was quickly changed to allow the packaging of circuits leased over many routes to qualify for discounts. Discounts varied with the number of channels rented; a discount of 85% was available with the largest system. Telegraph channels could be

bundled with voice channels to qualify for a discount at terms very favorable in comparison to the charges for individual circuits.

- WADS, Wide Area Data Service, was similar in concept to WATS except that it operated over the telephone industry's teletypewriter exchange network, TWX, rather than the telephone exchange network. The service permitted calling within designated areas at fixed charges, and large discounts were obtained in heavy usage situations.

• All three services, then, appear to have been discriminatory under the communication statutes because, in the broad sense, they permitted users in a particular economic class (e.g., those large enough to take advantage of the discounts for volume) to obtain service at prices very much lower than others.

3. THE FCC'S HANDLING OF THE INITIAL WATS, TELPAK, AND WADS TARIFF FILINGS

• Under FCC rules, a tariff filing can be suspended for a short period and then becomes effective (subject to refund) even though an investigation is undertaken as to its legality. Western Union was the only other long distance carrier at that time. It did not market voice systems, but it was directly effected by the Telpak and WADS offerings because it had competing offerings. The FCC undertook investigations into the legality of all three services, as was its custom with any significant filing, with these results:

- WATS was unopposed other than by Western Union which was perceived as having no direct interest. An investigation was quickly conducted, and the service was eventually approved.

- WADS was vigorously opposed by Western Union, and the Common Carrier Bureau within the FCC adopted Western Union's position. The Commission did not actually rule that the pricing structure was discriminatory, but it required that it be changed if approval were to be obtained. It also questioned the overall rate level and undertook an

investigation of the rates for the underlying service, TWX. AT&T responded by withdrawing the WADS tariff. The investigation of TWX rates eventually led to significant changes in the tariffs for that service.

- The WADS proceeding took about two years and ended mid-1963.

- Western Union also vigorously opposed Telpak with Motorola, who manufactured microwave. The Commission eventually found that the classes of service within the offering involving relatively few channels (Telpak "A" and "B" at 12 and 24 channels, respectively) were discriminatory in comparison to charges for individual circuits and were not justified as being necessary to meet competition from private systems. It also held that the classes involving large numbers of channels (Telpak "C" and "D") were justified by meeting the competition from private microwave systems, but it could not determine from the record before it whether the rates were discriminatory and undertook a further investigation to make this determination. This proceeding took four years and ended with only a partial resolution in December, 1964. Revenue from Telpak was of the order of $100 million at that time. Telpak "A" and "B" were cancelled; Telpak "C" and "D" were continued.

- The investigation of Telpak, when followed in 1965, was the first formal rate investigation of AT&T undertaken by the FCC. It was a watershed in the relationship, as was pointed out by AT&T's chairman to the Commission at the time.

4. DEVELOPMENT SINCE THE BEGINNING OF THE TELPAK INVESTIGATION

- The FCC's handling of the initial WATS and Telpak tariff filings had the effect of permitting AT&T to establish two services in the marketplace which were in conflict with fundamental principles of utility regulation. Users quickly became dependent upon them. The U.S. government's civilian and military arms became the largest customers.

- The FCC's later attempts to resolve the matter have been characterized by procrastination and indecision, as evidence by its activities regarding Telpak:

  - The investigation of whether the rates were compensatory was started in 1965; in 1969 the parties agreed to a Statement of Ratemaking Principles and Factors which was "noted" but not approved by the Commission. Two rounds of formal proceedings were required to get to the Statement of Principles.

  - By December 1972, formal hearings were concluded regarding rate-making principles and rates appropriate for various private line services, including Telpak. The Common Carrier Bureau did not issue a Recommended Decision until January, 1976, and the Commission issued its Final Decision in February 1977. In the Final Decision, the Commission reversed its 1964 opinion as to Telpak C and D and now held that they were not justified by competitive necessity. The Commission ordered that Telpak be eliminated by June 1977.

  - Meanwhile, the FCC had conducted an investigation regarding a second form of price discrimination in Telpak, which permitted only certain classes of users to group together to qualify for the discounts (e.g., its regulations as to sharing and resale) and it ordered AT&T to amend its tariffs by June 1977. Since this would have had the practical effect of permitting all users to qualify for Telpak discounts, AT&T indicated that it would withdraw Telpak rather than accept the revenue loss.

  - While this was in process, two large users objected to the FCC's order than Telpak be eliminated; and in June 1977, the commission reversed its order of earlier that year requiring that Telpak be cancelled.

  - The Commission's various orders were appealed. The court recently held in effect that, among other things, the Commission's order requiring unlimited sharing stands but rather than comply with its technical requirements, AT&T should be permitted to submit tariff

changes cancelling the service. These changes have not been filed, but are not in effect as of the date this is written.

- The proceedings affecting WATS have been as confused, but not as protracted. AT&T amended the original WATS service by adding INWATS in 1967. The addition was unopposed. In 1974 it filed tariffs restructuring WATS services, which the Commission allowed to go into effect. However, it later ruled that the rate structure was not justified by the data submitted. Tariff changes were again filed in 1977 and found by the commission to be unacceptable for lack of proof. In all, the FCC rejected five tariff changes through this period. Through this process, the 1974 structure remained in effect.

- MCI then appealed the FCC's decision regarding the 1977 tariff filing, alleging that the rates AT&T charges are too low (i.e., "predatory in effect and intent") and that there has been a clear pattern of AT&T filing unsupported tariffs which has the effect of giving it an unfair competitive advantage. The court cited an earlier Telpak case, and ordered the FCC to act. AT&T has recently filed a new proposed WATS rate structure.

  - "We are sympathetic with MCI's characterization of (the) proceeding" as interminable...the principal function of which has been that of a giant regulatory wastebasket. Though unwilling to impute ill motives to the Commission, we are constrained to agree with MCI (that)...there comes a time when proceedings that go on without conclusion is tantamount to refusing to address the issues at all..."

C. TRENDS IN THE PRICING OF COMMUNICATION SERVICES

1. STANDARDS EMPLOYED IN CONTROLLING AT&T'S PRICES

- Controlling a utility's prices is regarded as the central problem of public utility regulation. Because of AT&T's dominance of communications, con-

trolling AT&T's prices has been one of the FCC's two major activities for several years.

- As previously noted, formal ratemaking replaced the informal surveillance, negotiation method that was used by the FCC to control AT&T's prices through the 1940's and 1950's. Although the FCC uses written exchanges of view for policymaking, trial procedures are employed to set rates. As also noted, hearings have been protracted and complex.

- The FCC has had three goals in its ratemaking activities:

  - To limit AT&T's overall earnings. This sets a ceiling on the prices for broad classes of service such as MTS, private line, etc.

  - To control the pricing of AT&T's competitive services so that its monopoly services do not subsidize service categories that have competition and to prevent it from driving competitors out of business.

  - To adhere to the statutory standard of the Communications Act that prohibits a carrier from giving preferential treatment in its charges for aspects of service to particular customers or a class of customers.

- With regulation, a carrier's prices are controlled by measuring its costs, as contrasted with relying upon market forces to keep its prices down. The revenue goal for a utility service is often expressed as a "reasonable rate" which comes from the common law where in early cases it was called a "reasonable price" (pro mercede rationabili) or "whatever is deserving" (quantum meruit). A firm is permitted to recoup its capital over the life of its assets, cover its operating expenses, and obtain a profit from its investment. The formula used is $R = O + (V - D) \times r$. R is total revenue required, O is operating costs, V is gross value of the property, D is accrued depreciation of the property, and r is rate of return.

- Under modern theory, the rate of return allowed is the firm's cost of capital, which is the weighted average of the cost of its debt and equity financing. Because interest upon debt can be taken as a tax deduction, debt financing is usually considered to be less expensive than equity. One area of contention between the FCC and AT&T for many years was that because AT&T used conservative borrowing practices its cost of capital was higher than should have been, and therefore its prices were excessive.

- Prices cannot exceed the level that will generate the revenue needed by the carrier to cover its costs and profit, called the "revenue requirement". If the carrier provides several monopoly services, prices are set such that each service recovers its proportionate share of costs. If a carrier sells the same or similar services at rates which are not proportional to costs it is, by definition, unlawfully discriminating since some buyers will pay more than costs for one service while others will pay less than cost for another.

- Where a mix of monopoly and competitive services are provided, the carrier can forego profit to meet competitor's prices, but it can price down only to the level where costs are covered. If revenues from competitive services do not compensate for their costs, the loss would be subsidized by its monopoly services through prices that were higher than would otherwise be required and competitors would be wrongly harmed. The code words used in this context are "non-compensatory," "cross-subsidization" and "predatory".

- AT&T's MTS and WATS services have been treated as monopoly services, and its Private Line (e.g., single channel schedules) and Telpak have been treated as competitive services. The development of standards for pricing competitve services was undertaken by the FCC as part of the Telpak proceeding in the 1960's and is still continuing, the most recent event being the decision by the Appeals Court on the matter in June 1980. Most of the litigation regarding the pricing of competitive services has involved Telpak, but two Administrative Law Judges held in 1976 that AT&T's Dataphone Digital Service was anticompetitive and predatory because it was priced below cost to attract

customers from Datran. AT&T was required to increase the price of the service.

- Reaching a definition of the term "cost" has also required extensive litigation. The Common Carrier Bureau maintained in the Telpak proceeding that all costs among the various service must be shown, with the basis for the allocation, while AT&T contended that long run incremental costs could be employed in pricing new services. Historically, costs have been set using the fully allocated method, which sets a higher threshold than if incremental costs are used. Since a high portion of communication costs are fixed, the range between the two methods is large, and AT&T would have had considerable latitude in pricing its services using the incremental standard.

- As noted, the proceeding to set ratemaking criteria began in 1964. The commission ruled in 1977 that a particular method of full allocation, called "Method 7", is to be employed. The June 1980 decision by the Appeals Court upheld use of the fully allocated method.

- The first procedural step required to prove discrimination usually is to hold that one type of service is "like" another to form the basis of a contention that two similar services having similar costs are priced differently. The Commission has now ruled the MTS and WATS are "like" services, and appears to have established a basis for a ruling upon WATS discrimination.

2. BASIC TELEPHONE SERVICE

- The major features employed in the structure of toll telephone service (e.g., Message Telecommunications Service, or MTS) are as follows:

  - Usage sensitive pricing is employed, with separate charges for the initial interval and for subsequent intervals.

  - Charge increase with the distance between the calling and called locations. The same formula is employed without regard to the density

of traffic on the route the call takes or the location of the terminals; charges are averaged nationwide. Mileage steps are employed in determining charges: the underlying mathematical relationship is that charges increase in proportion to the log of distance, so increases decline in size as function of distance.

- Discounts of 30 and 65% for evening, night and weekend use are provided.

- Surcharges are applied for operator handling and coin-originated calls.

- Revenue from interstate calls is passed to local telephone companies as a subsidy through the separations and settlement process.

• Features of the MTS pricing plan have been widely copied. The pricing structure of Western Union's TWX service was originally designed by AT&T and is very similar. Domestic Telex is also similar. The design of Western Union's Broadband service and Datran's switched digital service employed variations of this plan.

• As competition began to emerge in long distance communications, MTS pricing was changed (in 1975) in two significant ways which had the effect of reducing AT&T's exposure:

  - Prices for calling long distances were reduced by factors up to more than a third while those for very short distances were increased somewhat. The concept of charging as a function of the log of distance was retained, but charges from about 50 miles now increase at a much lower rate than previously. The effect of this move upon carriers seeking to compete in the market for long distance communication is obvious.

- The three minute initial charge period was changed to one minute, which reduced the prospect of a competitor's isolating a sector of the market by employing shorter time intervals.

- The change in distance sensitive pricing implemented in 1975 was extended somewhat in a subsequent filing. Charges for calling over distances greater than 750 miles are now very nearly postalized.

- AT&T's strategy of reducing charges as a function of distance has not been opposed in a vigorous manner by the FCC. It was apparently satisfied that the reduction was justified by the lower costs associated with new technology despite the possible effect upon competition.

- The charge structure for international telephone service still is based upon a three minute minimum, while that for international Telex is one minute to most locations.

- There are two further steps that AT&T can take to counteract competition from the new telephone carriers such as MCI:

  - It can de-average charges for distance by going to route pricing, as it did with its single-channel private line service. Under the present climate of lessening regulatory controls, this step would probably not be opposed at the federal level, although states would probably react vigorously.

  - It can further reduce the charge interval by, for example, going to one tenth minute billing of the initial and subsequent intervals. Since charges are now rounded upwards to the next minute, some revenue is obtained in the form of hidden charges under the present scheme; and changing the interval would probably be done concurrently with some other change such as de-averaging to avoid the appearance of a price increase.

- Telephone charges have been increased somewhat in recent years, but at a rate lower than the rate of inflation.

3. WATS AND INWATS

- The design of WATS and INWATS pricing is based upon the MTS. The main distinquishing features are that a reduction in calling charges is obtained viz a viz basic toll telephone service and that a form of service is available that permit charges to be billed to the number called. The discount obtained is of the order of 35 to 50% for heavy business use, although it varies widely with total use.

- The design of the tariff provisions now in effect assume that charges increase in steps with the log of distance as is the case with regular toll service. However, the billing method is based upon the averaging of calls to each of five service areas on the basis of the relative use of each step. The underlying charge structure was tilted in 1974 and then changed again in 1975 when the new structure for regular toll service was implemented. Calling over long distances became relatively cheaper, with charges beyond 500 miles becoming nearly postalized.

- Two categories of service are provided under the rates now in effect:

  - Measured Time, which assumes a minimum of 10 hours of use per month with added charges at a discount of ruse beyond that level.

  - Full Business Day, for which a flat monthly charge applies.

- Charges are based upon a minimum call length of one minute. The same structure is used for both inward and outward service.

- As noted earlier, the FCC undertook an investigation of WATS rates at the time of the 1974 change. It has been pressing to have the rate structure changed by eliminating the flat charge element. AT&T filed proposed changes

in 1976 which the FCC then rejected because it could not determine if the structure was justified by costs. The 1975 filing continued in effect with upward adjustments to increase earnings.

- As noted earlier, AT&T has proposed a new charge structure that is not yet in effect at the time this is written. A small increase in overall revenue is proposed, but the change would cause substantial increases for very large users.

- The structure proposed has the following salient features:

  - Separate schedules for inward and outward service with inward slightly lower than outward.

  - Usage sensitive pricing with modest discount through heavy usage. The discount becomes substantial at very heavy use where much of the volume would fall outside the normal business day.

  - A fixed charge of about $30 per month, in contrast to the high fixed charge associated with the existing structure.

- Charges appear to be somewhat under those for basic service even at low volumes and around 25% for heavy use (e.g., about 60 hours per month).

- The revised structure may make the service economically more useful to smaller users than is the case with the present structure and may, therefore, be acceptable to the FCC, particularly since it is under a court order to act.

- However, the proposed charges appear to have the overall effect of segregating the market between occasional users and volume users, with residences and small business employing MTS and medium to large business employing WATS. The FCC may, therefore, determine that the new rates are discriminatory in relation to MTS and require that they be revised upward.

4. SINGLE CHANNEL PRIVATE LINE SERVICE

- The major features employed in the structure of AT&T's single channel private line services are as follows:

  - A fixed monthly charge for circuit ends and for mileage is employed regardless of the amount of use to which the circuit is put. Interest in shifting to usage sensitive pricing has been expressed by AT&T from time to time, but has not been implemented.

  - Decreasing rate steps over distance are employed. The steps appear to decrease proportionately with the log of distance but become flat at long distances.

  - Charges increase with the bandwidth obtained.

- With this structure, total charges for a circuit increase approximately linearly with distance, as opposed to the log of distance as is used with MTS and WATS. Leased circuits therefore become relatively more expensive at long distance than switched telephone service.

- Private line rates were traditionally based upon the airline mileage between ends without regard to the location of the terminations. The services authorized in the specialized carrier proceeding were based upon providing services over particular routes, as contrasted with averaging. In 1972, AT&T began testing the waters of the FCC regarding the acceptability of a pricing plan employing discrete routing. The early exchange was with regard to a bulk rate plan to replace Telpak, which was favorably received by the Commission. However, the provisions actually filed in early 1973 (called HiLo) applied to the single channel schedule. Although the FCC required several changes, it eventually accepted a de-averaged structure called Multi-Schedule Private Line or MPL, which is still in effect.

- Important changes implemented with the HiLo/MPL tariff were:

  - Charges for circuits among metropolitan centers are priced lower than those to and among rural areas. A three-tiered structure is employed.

  - Distance-dependent charges were shifted, with those for short distances now priced relatively higher than with the traditional method, and those for long distances priced lower.

- The structure employed in MPL appears to be entrenched. But, as has been discussed, AT&T is expected to drop Telpak in late 1980, which would cause present Telpak users to shift to the single channel tariff schedule and to pay higher rates. This action will increase AT&T's overall revenue and earnings, which should lead to reductions in single channel rates. However, some FCC ruling regarding private line rates were recently overturned by the Appeals Court; the effect that this action will have upon rate levels was undetermined at the time this is being written.

5. TELPAK SERVICE

- The essential feature of the Telpak tariff is its flat-rate discount scheme for voice and telegraph circuits in which large users obtain substantial discounts in relation to single channel rates. Discrete routing is not employed; pricing is based upon nationwide averaging. In other respects, the structure is similar to private line charges, with the price of a circuit increasing linearly with distance as opposed to the log of distance as is the case with MTS and WATS.

6. DATAPHONE DIGITAL SERVICE

- AT&T filed a tariff covering digital transmission in March 1974. At that time, Datran had digital services under development. The FCC investigated the filing in a long hearing.

- In strong language, the hearing judges held in July 1976 that:

  - The rates filed were based upon a competitive response rather than cost (e.g., AT&T had anticompetitive intent).

  - The rates were insufficient to cover the cost of providing the service (e.g., they were not "compensatory").

  - The tariff therefore should be rejected.

  - If AT&T wished to continue the service, it should be required to file rates no lower than those for data services obtained under the private line tariff schedules.

- The commission acted in January 1977 by accepting the hearing results except as to the conclusion regarding anticompetitive intent. AT&T was ordered to submit new tariffs with rates set such that they would provide a return at 9.5%. This requirement would have set rates above the threshold usually permitted for competitive services in which costs without earnings are recovered. Alternatively, it held AT&T could file rates based upon those single channel private lines. It did not prescribe rates, which it might have done under section 205 of the Act.

- AT&T responded by filing for end-to-end digital service that employed the private line structure and rate levels. The new rates were about 20% above the level originally proposed. This structure is still in effect.

- AT&T appealed only that aspect of the Commission's finding that the original rates were anticompetitive in effect and in violation of its policies of competition in private line services. The Court dismissed the appeal in May 1979 on technical grounds centered upon the fact that AT&T had accepted the ruling by filing revised tariffs without dwelling on the merits of the Commission's actions.

- The thrust of the Commission's activities regarding this new service are to be contrasted with its reaction to the initial WATS and Telpak tariff filings in the early 1960's.

7. PRIVATE LINE OFFERINGS OF OTHER CARRIERS

- The structure and levels of the rate for Western Union's terrestrial services have generally followed those set by AT&T. Some differences in pricing have developed, though, due to changes in the prices AT&T charges it for facilities and to distinguish its charges for teletypewriter grade facilities from those of AT&T.

- Discounts for quanitity have characterized the private line offerings of the specialized and satellite carriers. The discounts have been required to meet the competition posed by Telpak; they have not been opposed by the FCC.

- MCI originally employed a volume discount in the pricing of its Execunet, but it recently cancelled the feature.

- The cost of providing satellite service is unique in that cost is completely independent of the distance between terminals. However, the satellite carriers' tariffs employ rate steps as a function of distance, apparently for the purpose of addressing a broader market than would be possible if distance-insensitive pricing were employed while maximizing revenue from long-haul circuits. The structure employed permits them to compete for customers over heavily used routes such as Chicago to New York as well as the long-haul routes. This structure has also been accepted by the FCC.

D. THE FCC'S POLICYMAKING ACTIVITIES

1. A REVIEW OF ITS MAJOR ACTIVITIES

- The other important area of activity regarding common carrier matters at the FCC (besides ratemaking, covered in the section above) is its attempts to change the structure of the communication industry. Important proceedings of the last decade are as follows:

  - The 1968 Carterfone decision, which required that telephone companies permit customer-owned equipment to be interconnected with the telephone system, and the subsequent registration program that was finalized in 1976 and approved by the court in 1977.

  - The 1969 MCI case, the Specialized Carrier decision that followed, and the FCC's attempts to reject MCI's Execunet service in which it was overruled by the Appeals Court in 1977 and 1978.

  - Computer Inquiry I, closed in 1971, which barred AT&T from providing data processing services as regulated offerings and which, in conjunction with the terms of AT&T's 1956 consent decree that barred unregulated activities, completely blocking it from the field.

  - The Domestic Satellite Inquiry, which opened the domestic satellite field to competition and permitted it development time.

  - The sharing and resale cases which appears to have become the tool through which discrimination in private line charges is finally being eliminated.

  - Efforts to establish a new system of accounting standards so as to improve control of industry pricing practices.

- Efforts to revise the procedures for settlements between AT&T Long Lines and operating telephone companies.

- Revision of communication policy as to competition between the international record carriers and AT&T and the relationship of the international carriers to Western Union.

- Attempts to open areas of communication to competition through easing rules regarding entry and regulation of small non-dominant carriers and to protect small competitors through continued regulation of dominant carriers.

- Computer Inquiry II which, if not reversed in one or several of its holdings, will permit AT&T to provide communications-related data processing services and terminal products through a separate unregulated subsidiary and require it to detariff all terminal equipment, including telephone handsets.

• The overall thrust of these proceedings has been:

  - To establish a means of controlling the pricing of communication services so as to keep the large carriers' rates low and also to protect small vulnerable carriers in their efforts to develop innovative services. Specific actions of this kind are discussed in the previous section that is concerned with the FCC's ratemaking activities.

  - To open the provision of some communication services to competition within an overall framework of regulation through continuing formal regulation of large dominant carriers and easing the rules governing the entry and conduct of small carriers.

  - To permit AT&T to enter the market for communications services and terminal products that employ computers and data processing as enhancements. As noted above, it has been barred from these market

under the joint effect of the Computer/Communications Inquiry (Computer I) and the 1956 consent decree.

o The FCC's important activities in the last two areas are described in this section. Steps taken to inject competition into the provision of international communication services are also discussed.

2. SPECIALIZED CARRIER SERVICES

- Commission members appear to have been lukewarm over opening the long-haul dedicated channel market to specialized carriers at the time the policy establishing the industry was developed in the late 1960's and early 1970's. The push for the policy apparently came from the FCC's staff; the vote on the original MCI application was 4 to 3, with the chairman strongly dissenting to the action. Also, the Commission subsequently permitted AT&T to restructure its private line service so as to provide greater competition to the specialized carriers (see the discussion on HiLo/MPL service).

- The Commission's attitude towards competition in the industry has changed substantially. However, the scope of products that Specialized Carriers can provide was completely opened without its having any ability to control the matter as a result of litigation with MCI over its Execunet service.

  - MCI attempted to expand its product line by filing tariff provisions in 1974 which enabled it to market a public metered switched telephone service. Its intentions were not apparent from the tariff, and the Commission's concurrence in offering the service was not requested.

  - The Commission reacted vigorously. However, its all-out attempts to stop MCI failed when the Appeals Court held in 1977 that the Commission must first determine that there is a public need for limiting the kind of services that can be provided by a carrier before it can impose any restrictions. (See the section dealing with FCC powers for further discussion of the Execunet decision.)

- The Commission then attempted to recover the ground lost in Execunet by undertaking an investigation of basic long haul telephone services (e.g., MTS, WATS) to determine the arrangement that is appropriate to the industry (e.g., competition versus monopoly). Southern Pacific Communications, ITT and Western Union have been offering services of this kind while the investigation has been underway.

- At MCI's request, it also undertook an investigation to determine whether resale and sharing of MTS and WATS should be permitted.

- Specialized carriers must depend upon telephone companies to obtain access to local markets. States have jurisdiction over local communication. Many states did not agree with the policy set in the Carterfone and Specialized Carrier cases, and the telephone companies preferred to have states maintain jurisdiction over terminals and access facilities because they would receive more favorable treatment.

- However, the FCC was monitoring the local facility problems and acted as follows:

    - It ruled that provision of access facilities is also a matter of federal jurisdiction and required that AT&T file tariffs covering access facilities with it. It then undertook an investigation of the reasonableness of those tariffs.

    - It encouraged negotiations between the specialized carriers and telephone companies under which the specialized carriers agreed to pay a fee for using the local telephone system to reach their telephone customers. The fee is intended to offset the loss of the subsidy that local companies would have gotten if the specialized carrier traffic had been handled by AT&T. The rates negotiated by the various carriers were than approved by the Commission. They are viewed as temporary.

- The position that AT&T took in the MTS/WATS inquiry is a very improtant and significant change from what was to be expected on the basis of its past actions, and essentially mooted the investigation. In its comments to the commission in March 1980 it took the following stance:

  - That the basic question in the inquiry, whether telephone service should be a monopoly or opened to competition, had already been decided by the Execunet proceeding.

  - That new suppliers should be permitted to introduce and discontinue telephone services, including MTS/WATS-like services, without regulatory restriction.

  - That resale of all interstate services should be permitted.

  - And that improved access arrangements and access charges should be provided to enable carriers to develop and offer competitive MTS/WATS-like services.

- The taking of these positions in this very important proceeding may indicate that AT&T will now cooperate with the FCC in changing the industry along the lines discussed in the sections that follow. One reason for its change of heart may be that it now feels it will gain more through conciliatory actions than it achieved in the past. It may be willing to accept competition in its basic communication market (telephone service) with the hope that it will be allowed to participate in emerging markets that employ computer technology.

- The Commission ended that MTS/WATS market structure inquiry in April and initiated an investigation for the purpose of establishing a general solution to the problem of access charges for local exchange facilities. A long proceeding will probably follow. The long-haul telephone market is now formally treated as being competitive.

- In 1978, Xerox petitioned the FCC to allocate frequencies for use in wideband local distribution as an alternative to reliance upon the telephone system. A rulemaking procedure was undertaken the next year. The outlook appears favorable, but no decision has been reached.

3. BASIC AND ENHANCED SERVICE CARRIERS

- Indications that the FCC was beginning to visualize a segregation of carriers into two levels first appeared in the Shared Use/Resale decision of 1976. It was clear that the the FCC's goal was to achieve an industry structure in which AT&T functions as a wholesale carrier and supplies transmission facilities to other carriers who add functions such as processing and storage and then market a packaged service.

- The 1971 computer/communications decision (Computer Inquiry I) prohibited the provision of data processing services as tariff offerings and required that carriers marketing such services provide them through a separate subsidiary.

- As has been noted, the practical effect of the 1971 Computer I decision, when joined with the 1956 consent decree, was to bar AT&T from providing data processing services. A change in attitude towards this limitation became apparent following AT&T's attempt to tariff the Teletype Corporation's 40/4 CRT terminal, which contained computer features, in late 1975. The FCC staff rejected the tariff under Computer I. AT&T appealed the decision to the full Commission. It held that the device was a communications and not a data processing service and not subject to Computer I, and it accepted the tariff. The Commission then reopened the computer inquiry citing a "blurring" of the distinction between data processing and communications as a result of technological advances. The reopened investigation is called "Computer Inquiry II."

- In May 1979, the Commission issued a "tentative decision" in Computer II which contained the following elements:

- The product spectrum was divided into two sectors: simple "transducer type" equipment such as modems, voice telephones, and simple switches, which would continue to be supplied as part of telephone service; and anything more than that, such as intelligent terminals, augmented electronic private branch exchanges, or answering devices, would be supplied competitively and not by common carriers. A communications company supplying augmented terminal equipment would be required to do so through a separate subsidiary.

- The service spectrum was divided into three sectors: basic voice services, which were to remain regulated, basic non-voice services, which included plain transmission offerings such as AT&T's Dataphone Digital Service and were also to remain regulated, and "enhanced" non-voice services, which were services employing data processing to augment basic functions. Enhanced services were required to be supplied through a separate subsidiary as unregulated offerings.

- It was clearly contemplated by the Commission that AT&T would be permitted to provide enhanced communications services and products. This could violate the decree because such services would not be provided as tariffed products:

  - As stated earlier, the 1956 consent decree, which is of the nature of a contract between AT&T and the Department of Justice, provides that AT&T and its affiliated companies can not engage in any business other than furnishing tariffed common carrier communication services.

  - The decree contains an exception to the above which has now become important: AT&T is allowed to provide untariffed services that are "incidental to the furnishing ... of common carrier communication services."

- The FCC proposed to solve the problem of the consent decree by having the Commission determine whether an enhanced product or service is "incidental" under the decree to the providing of a tariffed communications service.

- It also attempted to avoid a conflict by arguing that the consent decree defines regulated services as those for which the prices are subject to regulatory scrutiny, and that the term "subject to scrutiny" does not require actual regulation only the power to regulate. It contends that it will maintain scrutiny of communication companies' enhanced services even though it does not regulate them.

• The tentative decision in Computer II was only a statement of principles. The final decision, reached in April 1980, is now law. It changes the principles of the tentative decision in three respects:

  - It requires that all terminal products, those of the "transducer type" such as handsets as well as enhanced, be provided as competitive offerings and not as tariffed services. (Discussed next.)

  - The distinction between basic voice and basic non-voice was not retained.

  - Only "dominant" carriers, which it defines as AT&T and GTE, are required to provide enhanced services and terminal equipment through separate subsidiaries. This change eases the requirement upon smaller carriers such as Western Union, who previously had to market data processing services, as defined under Computer I, through separate subsidiaries.

- The final decision in Computer II requires that existing enhanced services be detariffed. It also requires that the telephone companies detariff all customer terminals in two years. The FCC has already rejected applications for tariffing two new services because they appear to fall within the enhanced category.

- The Computer II decision, if it stands, would, of course, bring about fundamental changes in the structure of the communications industry, particularly with respect to the implementation of services employing the new technologies such as microprocessors. The appeal process has already started. The decision could be overturned on at least four possible grounds:

  - That there is inadequate justification for the substantitive aspects of the ruling. As discussed in the section dealing with the Commission's powers the court seldom substitutes its own judgement regarding substantive policy for the Commission's so long as the judgement was reached on reasonable grounds, and a reversal on this basis seems unlikely.

  - On technical legal grounds such as the existence of a defect in the Commission's procedure in reaching the decision. A reversal for this reason could occur, as happened in Execunet. However, the effect of a decision of this kind would probably just be to send the Commission back to the drawing boards; it would result in delay but not reverse the general course of policy. Several Commissioners did criticize aspects of the opinion in dissenting comments, but the vote was 5 to 2.

  - That the ruling conflicts with the provisions of the 1956 AT&T consent decree, and that the consent decree is controlling.

  - That the FCC can not refrain from a statutory duty to regulate.

- As just discussed, the Commission justifies its ruling regarding the provision of untariffed services upon an interpretation of the term "incidental to" that

extends to terminal equipment and enhanced communication services, as opposed to clearly secondary services such as directories. The Department of Justice has made it clear that it does not accept this definition. It has taken the position that the FCC has no legal authority to interpret the decree and has stated that it will disregard the ruling in exercising its discretion as to enforcing the decree in the future.

- Its position, if maintained, could lead to the decision's being overturned by a court. However, it is observed that:

    - The Justice Department's positions have often been short-sighted and at odds with FCC policy and court decisions in communications matters. For example, its position in the 1977 Telpak appeal was in favor of continuing the service.

    - The provision of the decree at issue is in fact anti-competitive because it bars AT&T from large business areas.

4. INTERCONNECTION AND THE PROVISION OF CUSTOMER PREMISES EQUIPMENT

- Policy regarding the use of customer-provided equipment on the communication network was fixed in 1976 when the FCC adopted the terminal equipment registration program that permitted any equipment meeting standards to be used on the network. This program was reviewed by the Appeals Court and upheld in 1977.

- As just noted, in its recent decision, the FCC held that terminal equipment markets should be completely opened to competition and ruled that all carriers must detariff such equipment and that AT&T and GTE can provide it only through an unregulated subsidiary.

- One possible ground for reversal of Computer II, not covered in the earlier discussion, is that terminal equipment markets fall within state and not

federal jurisdiction. While there were conflicting opinions regarding jurisdictional matters in prior court cases, this issue appears to have been settled in the 1977 Appeals Court decision regarding the registration program. The Computer II decision is therefore unlikely to be overturned on this ground.

- The FCC excluded over-voltage protection equipment, inside wiring, coin operated telephones and multiplexing equipment from the reach of Computer II. Regulation of premises wiring therefore remains a matter of state jurisdiction. The New York Public Utilities commission ruled in January 1980 that customers can own their own inside wiring. Staff members of the state regulatory commissioners association (NARUC) recently recommended that all states follow the lead of New York.

5. REMOVING PROCEDURAL REGULATORY REQUIREMENTS FOR SMALL CARRIERS

- The FCC has opened interstate telecommunications markets to competition over the last decade. The traditional regulatory tools for controlling tariffs and facility expansion have been applied to the new carriers despite the fact that most of them are small and have limited resources, causing administrative delay and added cost and exposing some of their proposed actions to the risks of failure associated with legal procedures.

- A rulemaking inquiry is underway at the FCC to ease the burden of these regulatory procedures upon some carriers, and it is now reaching resolution. Elements of the approach that will be employed are believed to be as follows:

  - Carriers will be categorized as "dominant" or "non-dominant":

    - Dominant carriers will be defined as those having sufficient market power in some important respect that they are essentially immune from competitive control

- Non-dominant carriers are those who are subject to effective competition in their regulated market.

- Those who are treated as dominant are:

  - AT&T and all other telephone companies because of their control over local facilities.

  - Western Union with respect to its Telex and TWX record message services.

  - The domestic satellite carriers, which are Western Union and RCA, because of the current shortage of video transmission satellite facilities.

- Those to be treated as non-dominant include:

  - Terrestrial specialized carriers such as MCI, Southern Pacific Communications and U.S. Transmission (an ITT subsidiary).

  - Resale carriers, of which there is reported to be 17.

  - American Satellite and SBS, since they do not offer or plan to offer video transmission.

- Specific procedural requirements eased for non-dominant carriers will probably include the following:

  - Economic support data (e.g., market and cost data) will not be required with the filing of tariffs. This data is now required under section 61.38 of the FCC's rules.

  - The period for which tariff filings are suspended would be reduced from 90 days to 14.

- Circumstances under which approval must be obtained to construct or expand facilities would be substantially reduced.

- It is quite likely that the Commission will adopt these changes in the near future.

E. OTHER DEVELOPMENTS AFFECTING INDUSTRY STRUCTURE

1. REVISION OF THE COMMUNICATION ACT

- Historically, Congress has had little interest in revising the Communication Act, possibly because the nation has traditionally had excellent communications service. However, interest has recently developed in strengthening the legal framework of the industry, partly as a result of the confrontation over the past decade between AT&T and the FCC, and partly also due to the general interest in deregulation as a subject in and of itself. This interest in deregulation led to legislation in the airline, trucking and railroad industries.

- Activity within Congress has gone through three distinct phases:

  - First was the telephone industry's attempt to have the Consumer Communications Reform Act (popularly called the "Bell Bill") passed in 1976. This legislation was pressed as a grass roots movement. Despite its name, it would essentially have preserved the status quo: industry structure would remain unchanged; AT&T's monopoly of long-distance telephone communications would have been blessed; and the FCC's regulatory pressures would have been neutralized by shifting jurisdiction to the states. The bill quickly gained a surprising amount of support among legislators but did not pass.

- Second was the proposed complete revamping of communications law to shift the means of control from regulation to competitive forces. This proposal was developed within the House Communications Committee by Representative Van Deerlin and introduced in June 1978. The bill would have replaced the FCC with a Communication Regulatory Commission which would have had ratemaking authority and responsibility for frequency management, but no rulemaking authority. Vertical integration of the industry would have been prohibited. AT&T would have been permitted to provide data processing services through a separate subsidiary.

- The second approach was abandoned by Van Deerlin in 1979 in favor of amending the present Act to support policies already under development by the FCC. Similar legislation has also been proposed within the Senate Communications Subcommittee. there are many differences in detail; Van Deerlin's bill appears to have the best chance of eventual passage.

• Action by Congress is generally viewed as desirable even by those who support the Commission's specific rulings in order to avoid the uncertainty and delay resulting from litigation, particularly with respect to Computer Inquiry II. As just noted, Van Deerlin's bill, HR 6121, generally follows and supports recent developments within the FCC, but was stalled in the House Judiciary Committee at the time this is written. Important aspects of HR 6121 are as follows:

  - The bill provides that the AT&T consent decree should not be read to bar AT&T from participating in unregulated telecommunications markets or markets found by the FCC to be incidental to communications.

- It would require separate subsidiaries for regulated and unregulated services and products. However, it would extend the separation concept to business dealings between carriers and affiliated suppliers such as Western Electric.

- The bill addresses both discrimination and anticompetitive behavior. Thus, for example, the use of discounts in the leasing of circuits could be barred by the FCC if they harmed competition even if not discriminatory.

- It supports the concept of competition in long distance communication.

- It abandons the concept of "interstate service" and gives the FCC jurisdiction over "intraexchange carriers", which includes facilities employed for intraexchange service within a state.

- In addition, it supports the concept of requiring all long distance carriers to bear a portion of the costs of local access.

• The FCC's rulemaking authority would have been retained with the bill's passage.

• A separate bill repeals the provisions of Section 222 relating to international communications, but it also has little chance of passage by this Congress.

• The strongest criticism of the provisions of HR 6121 have come from organizations objecting to permitting AT&T to compete in markets now barred to it by the consent decree.

• The bill was tabled by the Judiciary Committee "without prejudice" to permit study of its antitrust implications.

2. THE ANTITRUST SUIT AGAINST AT&T

- The Department of Justice's suit against AT&T is nearing the trial phase. The charge is unlawful monopolization of telecommunications equipment and services markets. The objective is separation of AT&T into independent organizations, as opposed to constraining its activities through a court injunction or consent decree. The specific form of relief sought is:

  - Separation of the ownership of intercity facilities from the ownership of local telephone facilities.

  - Separation of the providers of telecommunications services from the manufacturer of telecommunications equipment, including its research and development.

- In other words, the Department of Justice is seeking to break Long Lines from the operating telephone companies and to break Western Electric and Bell Labs from both entities. If the Department of Justice is successful, AT&T will become at least three units and possibly more.

- The suit is one of the longest, most complex proceedings in history. It will probably be several years before a decision is rendered, although pressure for some form of negotiated settlement appears to be building. It seems likely that having come this far that AT&T will be severely affected by the outcome which could take any of a variety of forms and cannot be predicted at this time.

- Events surrounding the settlement of the antitrust suit brought in 1949 indicate the range of possible outcomes. That suit sought the separation of AT&T's service arms (Long Lines and the operating companies) from manufacturing (Western Electric) and the splitting of Western into three entities. AT&T rejected a compromise. Attorney General Brownell was approached by an AT&T vice president, and Brownell suggested to him that there must be practices that AT&T could agree to have enjoined that would do no real injury to its business. AT&T acted upon the suggestion, and the terms of the present consent decree were accepted by both parties. The terms have little

relationship to the original objective of the suit and in some respects actually harm competition rather than help because AT&T is barred from competing in markets other than tariffed products and service.

- Separating AT&T into distinct corporations (the Justice Department's goal) is a much more radical remedy than merely requiring that customer premises equipment and enhanced services be marketed through a separate division (the FCC's goal). There are at least two important differences:

  - Markets within the present organization for equipment such as switches would also be opened to competition through separation.

  - AT&T's enterprises in competitive markets would be smaller and more exposed than a single integrated company. An integrated company has deeper pockets than the pieces of a separated company would have individually.

F. IMPLICATIONS

1. IMPLICATIONS REGARDING EXISTING COMMUNICATION SERVICES

- It is probable that changes underway will lead to a basic restructuring of long distance telephone rates. AT&T can be expected to abandon the concept of nationwide averaging as competition develops and to go to some form of route-sensitive pricing in which calls to rural, less dense areas will be at higher rates than those among metropolitan areas.

- The relative levels of local and long distance charges may also change as the volume of traffic handled by the specialized carriers increases, with long distance charges becoming relatively less expensive. However, procedures are being developed to protect the existing subsidy of local rates, but this trend could be temporary.

- It appears that the present industry practice of providing discounts for volume, as embodied in the present Telpak and WATS rates and the matching rates of other carriers will stop, perhaps as the result of tariff changes already filed by AT&T. Resale and sharing can be expected to spread to MTS and WATS and to international services. Much of the Commission's activities have focused upon discrimination against small users, and the practice should cease at some future time even if the changes now proposed do not come to fruition.

- Moves by AT&T to make its services less vulnerable to competition by reducing the relative charges for communicating over long distances, reducing fixed charges and reducing minimum charge periods can be expected. The recent WATS filing employed several such changes. Others, such as a reduction in the minimum period of international telephone calls, are to be expected.

2. IMPLICATIONS FOR USERS

- The most significant benefit that users will obtain is the more rapid development of new forms of service made possible by rapidly changing technology. A competitive market structure should encourage innovation. Permitting AT&T to participate in all areas of communications should increase the speed at which new technology is widely applied as a result of its vast financial resources and the spur of competition.

- Some upheaval in the rates of existing communications services may occur as a result of the changed policies. In general, changes in marketing practices similar to those that have occurred in the airline industry are to be expected. Lower prices should occur in some service areas, although the effects upon pricing is a much more complicated matter than might seem at first impression. Technological innovation is a stronger reason for change than effect upon overall price levels.

- Discrimination in the pricing of communication services will probably lessen. A more uniform pricing system for switched telephone service and leased lines should develop as a result of recent court actions regarding WATS and Telpak.

3. IMPLICATIONS FOR OTHER COMMON CARRIERS

- Nothing is underway that will affect AT&T's status as a regulated common carrier whose prices are based upon costs. Therefore, AT&T's overall charge levels will continue at approximately their present level, providing an umbrella under which competitors can price their services regardless of the FCC's stated intentions in this regard. However, as noted immediately above, AT&T can be expected to reduce the market windows seen by its competitors through restructuring parameters such as price as a function of distance and minimum charges.

- AT&T will be free to introduce innovative communication services, such as ACS, as a regulated entity and via an unregulated arm, as appropriate.

- Entry to almost all markets will be possible, but participation on an equal footing with AT&T, such as in regard to dial number plans and providing joint service, will be slow in developing.

- Increased protection from predatory pricing tactics by AT&T in competitive services will be implemented by the FCC. Its reaction to the initial pricing of Dataphone Digital Service and its steps to prevent cross subsidy such as developing improved accounting standards indicate that it is now alert to this danger.

- Small carriers will be free of much of the administrative burden now generally associated with regulation. However, this change will probably be of relatively little practical importance because the FCC has been reluctant to rigorously apply its procedures to small carriers for several years. The proposed changes associated with deregulation of small carriers are probably significant only as a political maneuver in an election year.

4. IMPLICATIONS FOR EQUIPMENT SUPPLIERS

- Passage of revisions to the Communications Act or an upholding of the Computer Inquiry II decision in the courts will lead to increased competition in terminal markets outside of AT&T's traditional product areas as a result of its entering markets previously closed. It will probably develop momentum slowly, but it can be expected to become a formidable competitor over time.

- Prices for its traditional terminal products may increase as a result of faster depreciation.

- Greater freedom of action in providing interconnect systems may develop through state action regarding premises wiring.

5. IMPLICATIONS FOR ENTREPRENEURS

- New organizations will be free to enter the market for communications and communication-based information services as a result of the policy of competition. As a practical matter, though, freedom of entry already exists except to the extent that the regulations of the FCC are an administrative burden. As noted above, the FCC has not been rigorous in enforcing its procedures against small organizations, and the change in policy probably is of relatively little real importance.

APPENDIX E: SPECIFIC COMPANY SERVICES

APPENDIX E: SPECIFIC COMPANY SERVICES

A. COMMUNICATION SATELLITE SERVICES

1. WESTERN UNION TELEGRAPH COMPANY

- The company's Westar satellite system uses three geostationary satellites which service the seven earth stations located in six states: Alabama, California (two in this state), New York, Texas, Washington, and Wisconsin.

  - Integrated with the company's 9,000 mile terrestrial microwave network, its services extend into 25 major city calling areas within the domestic United States to provide a variety of voice, data and video communications transmission capability to businesses and other organizations.

  - The company expects to expand its satellite earth station capability to other cities over the next couple of years, but has not made public any specific timetable.

  - Also available is an extension service outside of the local exchanges currently for Atlanta, Chicago, Los Angeles, New York, St. Louis and San Francisco for a nominal charge of $30 per channel. The service is

made available as appropriate by either the company's terrestrial microwave or land line facilities.

- In addition to the expansion of earth station facilities being planned, the company expects to make the extension service available in other areas as well, but has not revealed any timetable for this expansion to date.

- Western Union has plans to share a four-satellite system called Advanced Westar that it developed for NASA following its sponsorship of an 18/30 GHz Fixed Communications System Service Demand Assessment completed in July 1979.

  - The company has reached an agreement with ASC to share the commercial capacity of the second-generation system developed for NASA for tracking and communications purposes.

  - Present Westar users will be assured of continued service through the C-band coverage of the new system. Ku-band capability will be added to provide for new digital services, including both roof-top to roof-top operations, and the expected Ku-band 250 Mbps switched digital services to be offered through new earth stations which the company will develop to serve the areas surrounding New York, Chicago and Los Angeles.

2. RCA AMERICOM

- RCA Americom's satellites (Satcom I, launched in December 1975 and Satcom II, launched in March 1976) along with its network of eight earth stations and three other communications centers which are linked via land-lines interface with major business centers for satellite and private-line services for voice, data and/or alternate voice/data applications.

- As with ASC, a much larger number of cities can access the network, but at greater distances at the added expense for local loop facilities. The RCA services operate at speeds up to 9600 bps only.

- The company provides total turnkey services for a flat monthly fee comprised of three elements: Satellite Channel Charges; Channel Termination Charges; and Local Access Termination Charges.

    - Private leased channel rates are based on these charges and tariff rates allow discount rates of 20% for 12-33 circuits and 30% for 24 or more circuits.

- A 56Kbps digital data service is offered as a two point service only, between selected network locations as indicated in RCA's tariff, FCC #1.

    - This service, as does the 1.5 Mbps digital data service, assumes the use of either customer-based (on-premises) leased or purchased earth station equipment.

    - Users of these services are typically government agencies, but the company does not exclude large corporate users as prospects for these all digital services.

3. AMERICAN SATELLITE COMPANY

- American Satellite Company is a joint venture of Fairchild Industries and Continental Telephone, each of which invested a sum of $12 million to establish an equal partnership in the new satellite communications venture.

    - The company had formerly leased transponder capacity from Western Union's Westar satellite communications system. American Satellite Company recently reached an agreement whereby it would share the ownership of the Westar system, including the rights to utilize half of the commercial capacity of the TDRSS (Tracking and Data Relay

Satellite to be constructed for shared use with NASA by another Western Union subsidiary in the 1980's.

- American Satellite Company offers two distinct types of satellite communications services: Dedicated services (where earth station equipment is located on the customer's premises) and Commercial Services.

  - For dedicated services users, American Satellite Company offers its SDX (Satellite Data Exchange) service which utilizes five meter antennas to provide one or several 56 or 112Kbps channels. The various communications devices employed by the user interface with a single 56 or 112Kbps channel through a DCC (the Digital Communications Controller), a flexible interface which accepts analog or digital voice, data, facsimile, or "freeze-frame" video traffic, and converts it all into a digitally-combined bit stream which is transmitted over the single satellite channel.

  - Another version of SDX is the new SDX Metroline, a 56Kbps transmission service incorporating all of the features of SDX and also allowing multiplexed channels to be separated for different customers sharing a roof-top earth station at one of the customer's locations. The various customers can gain access to the earth station via an intra-building fiber-optic or coax cable system or via digital microwave radio for a distance of up to 15 miles.

  - The deregulation of receive-only earth stations by the FCC allowed the company to announce another new service for dedicated services users called ADX (Asymmetric Data Exchange), an all digital bulk data transmission from a host computer to remote terminals. The service operates at speeds of 9.6, 19.2 or 56Kbps to offload the host, and uses 4800 bps terrestrial links for return data from the remotes.

  - The newest service available to dedicated services users is called DDX (Distributed Data Exhchange) for distributed network usage with a

combination of voice, data and facsimile traffic. Utilizing three meter send/receive antennas, DDX permits 9600 bps channels to be configured for various types of traffic or individual channel assignations for data, facsimile or digital voice to be transmitted or received in a variety of time schedules.

- American Satellite Company's Commercial Services are maintained via its earth stations located in New York City, Dallas, San Francisco and Los Angeles. The company also maintains major centers interconnected via terrestrial microwave and cable links in Atlanta, Boston, Chicago, Houston, Philadelphia, San Antonio, Seattle and Washington, D.C.

  - From these 12 basic calling cities, American Satellite Company provides access to more than 200 cities nationwide.

- SVX (Satellite Voice Exchange) is the company's major commercial services offering; a shared use service, it avails a number of subscribers to contend for available channels at substantially lower rates than for dedicated channels.

  - SVX is presently restricted to the exchanges local to New York City, Chicago, Los Angeles and San Francisco. The service is only available for the city pairs of: New York-Chicago, New York-Los Angeles and New York-San Francisco.

  - The basic commercial service is the provision of 3Khz voice-grade, interstate channels on a dedicated usage.

4. SATELLITE BUSINESS SYSTEMS

- Satellite Business Systems is a partnership between the arm's-length subsidiaries of Comsat General Corporation, IBM Corporation and Aetna Life and Casualty Insurance. These wholly-owned subsidiaries are respectively: Comsat General Business Communication, Inc. (Comsat); Information Satellite Corporation (IBM); and Aetna Satellite Communications, Inc. (Aetna).

- Satellite Business Systems is expected to provide communication services to commercial and governmental users having large-volume communications requirements over dispersed geographic locations within the 48 contiguous United States via its domestic satellite system.

  - The proposed SBS service is expected to begin operation in January 1981 utilizing the first of two satellites (to be launched November 6, 1980) to be placed in geostationary orbit.

  - The proposed service, called Communications Network Service (CNS), will employ 14GHz up-links to access some portion of one or more of the ten active transponders on each satellite which operate independently to translate and amplify the signal for re-transmission over a 12GHz down-link carrier.

- CNS is intended as a communications service for two-point or multipoint transmission of digital information filling applications in voice, data and image traffic.

  - The provision and maintenance of earth stations (a minimum of two which may be shared with other users) by Satellite Business Systems, will sustain a minimum cost to a single user company of about $50,000 per month.

- Series B Communications Service (CNS-B) is expected to be available at the following service points (in addition to customer-premises earth stations):

  - Atlanta, GA
  - Boston, MA
  - Chicago, IL
  - Cincinnati, OH
  - Dallas, TX
  - Denver, CO
  - Detroit, MI
  - Minneapolis, MN
  - New Orleans, LA
  - New York, NY
  - Philadelphia, PA
  - Phoenix, AZ
  - Pittsburgh, PA
  - St. Louis, MO

- Houston, TX
- Los Angeles, CA
- Miami, FL
- San Francisco, CA
- Seattle, WA
- Washington, DC

5. XEROX CORPORATION--XTEN

- The XTEN system differs from other satellite services in that the only way to access the leased transponders will be via digital microwave links from the customer premises to local/city nodes owned and operated by the XTEN subsidiary.

  - The entry cost to the XTEN network, for a single user company, will be much lower than alternative services requiring customer-premised earth stations.

- XTEN expects to utilize digital links, operating at speeds up to 256Kbps, to transmit/receive documents, data and freeze-frame video teleconferencing signals.

  - When the distance of transmissions is more regional (e.g., when local node terrestrial microwave is more cost effective), the satellite will not be used. This is a likely alternative for short-haul or intra-state communications.

  - This methodology, in concert with the lower cost of user entry into the network, will broaden the market potential for XTEN services.

- The XTEN system is proposed to serve up to the top 100 SMSA's and to begin operation by the mid-1980's.

6. GTE/TELENET

- In a plan expected to augment existing facilities, GTE/Telenet will employ company-owned earth stations co-located with its major central offices in

concert with leased transponders to provide satellite-based packet-switched communications services.

- The system will provide operating sppeds from 56Kbps to 1.544Mbps to extend the range upward from current service offerings which cater to users of data communications equipment operating at speeds down to 75bps.

- The company has announced its intention of utilizing available 10GHz frequency allocations for digitally-formatted microwave transmission signals for local distribution of satellite transmissions.

- In addition to provision of services aimed at digital facsimile, communicating word processors and intelligent copiers, the company will proceed with plans to implement Telemail services (now deregulated as an enhanced service) via a combination of satellite and terrestrial microwave systems, as appropriate on a regional basis.

7. AT&T

- AT&T, through a consent arrangement with the FCC which forbade the company's participation in the commercial provision of satellite communications services, has recently noted the end of the seven-year moratorium designed to allow the smaller carriers (Amsat, RCA and Western Union) a fighting chance or head start in establishing market share in the domestic U.S.

- As might be expected, these smaller carriers are attempting to influence the FCC to extend the moratorium for another seven years or, at the very least, until after the next generation of satellite systems have been launched and made operational.

- Considering the demand assessment through the year 2000 as prepared for NASA by Western Union, it is likely that sufficient market share exists for profitable growth for all three carriers as well as SBS, XTEN and AT&T.

- In any event, it is more likely that AT&T would commence its services offerings via one or more of the three Comsat satellites presently used only for alternative long-haul traffic routes by AT&T Long Lines.

B. VIDEO TELECONFERENCING

1. COLORADO VIDEO INC.

- Colorado Video has extended the value of using still pictures or graphic images to facilitate communications among individuals and groups through a technology referred to as slow-scan television.

  - Slow-scan transmission and reception uses ordinary telephone lines (one, two-wire pair for each direction of transmission since simultaneous transmission requires a separate line for each direction) connected to a coupler at each point, a video compressor at the sending point, video expandor at each receiving point, a television camera (or tape device) at the sending point and a television monitor (or taping device plus monitor) at each receiving point.

- Slow-scan television is made possible through the use of video compression, a technique which converts standard television signals to narrow bandwidths while stretching out the time required for full transmission.

  - The extended time required for transmission of the compressed signals limits the technique to still image transmission but provides high-picture resolution.

- The dial-up phone network provides a useful frequency range for a circuit from 300 to 2500 Hertz. To accommodate the necessary DC component in the slow-scan television signal, either amplitude or frequency modulation of an audio tone is used resulting in an effective bandwidth of about 1KHz or 2000 picture elements per second.

- Within this bandwidth constraint it would take upwards of 64 seconds to obtain resolution of 256 X 512 picture elements which provides good useful images. Excellent images can be obtained at higher resolutions but at the expense of more time.

• An important consideration for users of slow-scan television is perceived or subjective time elapsed for image transmission. While the technique is faster than most facsimile equipment, it is not typically used for the same generic applications.

- For most users, it is unnecessary to operate the video portion of the communication in a strictly real-time sense. By adding a video memory device between the expander and the monitor which can be activated at will by the receiving party, and with the use of a separate telephone line to carry the audio communications, real time can be closely approximated.

- An added advantage of a video memory is that a user can easily refer back to images already discussed; something which cannot otherwise be done without lengthy re-transmission, and, finally, the line used for video transmission can be disconnected once all images have been transmitted while the teleconference continues.

• At added expense, a user can shorten transmission times through the utilization of wider bandwidth channels. An AM broadcast circuit (100 to 5000 Hertz) can halve transmission time while FM circuits (30 to 15,000 Hertz) can reduce transmission times by a factor of eight without degrading resolution and with room to spare for a simultaneous voice channel.

- Colorado Video has installed slow-scan systems for NASA, the Naval Oceanographic Systems Command, MITRE, Block Island, University of Waterloo and more than 20 other research organizations and a number of industrial companies in the U.S.

- A complete two-point system varies in price according to the resolution desired, the quality of comeras used (black and white or color) size of monitors, etc.

  - The general price of systems ranges from about $9,800 for a medium resolution system including black and white monitors (17"), video camera, compressor and expanders to more than $22,000 for a high resolution system with transmission time of images dependent on the bit rate of modems used.

2. BELL SYSTEM--PICTUREPHONE

- The Bell Picturephone Service provides for the transmission and reception of moving images over telephone lines; for private installation, it requires the addition of a two-wire pair for transmitting and another pair for receiving in addition to the existing wire pair for audio transmission.

  - For the Bell System, the modification of subscriber station lines rather than replacement is a considerable savings in cost, yet Picturephone has had little impact on private industry to date.

  - In 1979, AT&T had a reported 552 calls on its Picturephone Meeting Service, nationwide, accounting for $125,524 in revenues. At a mean average of $227 per call, this represent calls not exceeding one hour on average.

- The Bell System is now placing its marketing efforts on Picturephone Meeting Services in an apparent effort to compile more market data on the service on a nationwide basis to provide a basis for appropriate 214 application filing upon the expiration of the trial tariff #263 in June 1981.

- Early Picturephone equipment required a minimum bandwidth of 1MHz to transmit moving (or still) images at 30 frames per second; each frame being comprised of 250 lines of 211 picture elements each.

    - In early designs of private Picturephone units, the television monitor had a screen size of 5½ by 5 inches and was intended for viewing at a distance of up to 36 inches away. Today, only larger screen monitors are used either in Bell meeting room facilities or in customer premises, such as those at Ford Motor Company.

- The Picturephone service has the major advantage over slow-scan techniques of instantaneous transmission and reception of both moving and still images.

    - The resolution of the picture has been criticized as somewhat lacking in quality as compared to normal television broadcasts but admittedly useful for most applications.

    - Bell Labs has recently announced improvements in the logic used for psuedo-random sampling of the picture elements used for video compression which holds out promise for higher resolution without requiring wider bandwidths or degradation of the transmission rates.

    - Planned future installations of fiber optic cables also hold promise for more bandwidth capacity which could then allow higher resolution by increasing the effective bandwidth.

- As with slow-scan television, Picturephone is promoted as a viable alternative to travel in accomodating meeting participants.

- Despite the problems associated with the psychology of its use, Picturephone is found quite useful and cost-effective by longer-term users.

- One of its major drawbacks for new users is that it is fun to use, and, as such, often taken too lightly as an effective communications medium.

  - It is also true that the logistics of planning for meetings are complicated to a large extent by the medium itself, but, as experience is gained, this can become routine; the Bell staff can be and should be called upon to simplify meeting planning by old and new users alike.

APPENDIX F: VENDOR INTERVIEW OUTLINE

APPENDIX F: VENDOR INTERVIEW OUTLINE

- Vendors were contacted and interviewed on specific products or families of products which were established as important during the course of the user interviews.

- Since each vendor or group of vendors was interviewed on a different product area, an interview outline rather than a specific questionnaire was used.

- The following topics were discussed with each of the vendors.

  - Description of the product or product line.

  - Applicability of the product to large user networks.

  - Advantages to users.

  - Advantages of this product versus competitive alternatives.

  - Present level of user acceptance (or delivery status if not yet in full production)

  - Future expections of the vendor for this product area.

  - Marketing methods used to sell this product.

- The user and vendor interview programs are illustrated in Exhibits F-1 and F-2.

EXHIBIT F-1

USER INTERVIEW PROGRAM
FORTUNE 500/50 COMPANIES

INDUSTRY SECTOR	NUMBER OF COMPANIES INTERVIEWED	NUMBER OF COMPANIES INTERVIEWED ON SITE	NUMBER OF COMPANIES INTERVIEWED BY TELEPHONE
ALL COMPANIES	149	48	101
DISCRETE MANUFACTURER	49	12	37
PROCESS MANUFACTURER	44	20	24
BANKING	11	2	9
DIVERSIFIED FINANCIAL	7	4	3
INSURANCE	6	1	5
TRANSPORTATION	7	2	5
UTILITIES	10	4	6
RETAIL	13	3	10

EXHIBIT F-2

VENDOR INTERVIEW PROGRAM

TYPE OF ORGANIZATION	
• SERVICE VENDORS	
– COMMUNICATION SERVICES	8
– DATA PROCESSING AND OTHER SERVICES	4
• MANUFACTURERS	
– COMPUTER EQUIPMENT	3
– PBX EQUIPMENT	3
– LOCAL DATA NETWORK SUPPLIERS	6
– MICROWAVE/INFRA RED EQUIPMENT	5
– OTHER COMMUNICATIONS EQUIPMENT	7
• OTHER	
– GOVERNMENT AGENCIES	3
– INDUSTRY GROUPS	3
TOTAL	42

APPENDIX G: QUESTIONNAIRES

CATALOG NO. XCOM

7/16/80

GENERAL INFORMATION

			$	# Of Emp.	# Of Plants	Growth Rate
(X) Company Size - Total			1 ____	2 ____	3 ____	4 ____
By Product Area	5 ____	________	6 ____	7 ____	8 ____	9 ____
	10 ____	________	11 ____	12 ____	13 ____	14 ____
	15 ____	________	16 ____	17 ____	18 ____	19 ____
	20 ____	________	21 ____	22 ____	23 ____	24 ____
Fraction of International			25 ____ %	26 ____ %	27 ____ %	28 ____ %

Basic Corporate Organization

29 { - Strongly Centralized 1
- Independent Subsidiary 2 How many? 30 ____
- P & L Divs./Departments 3 How many? 31 ____

NUMBER OF EMPLOYEES

	Total	1-49	50-999	1000-2999	3000+
(X) Number of Locations - Total	32 ____	33 ____ %	34 ____ %	35 ____ %	36 ____ %
Number of Plants	37 ____	38 ____ %	39 ____ %	40 ____ %	41 ____ %
Number of Warehouses	42 ____	43 ____ %	44 ____ %	45 ____ %	46 ____ %
Number of Sales Offices	47 ____	48 ____ %	49 ____ %	50 ____ %	51 ____ %
Number of Other Locations	52 ____	53 ____ %	54 ____ %	55 ____ %	56 ____ %
Number of Overseas Locations	57 ____	58 ____ %	59 ____ %	60 ____ %	61 ____ %

GENERAL INFORMATION - (continued)

Any studies done? Available?

- On networks?
- On traffice volumes?
- On applications?
- On equipment?

Any experimental services tried? Results available?

(X) Systems maps/directories available?

Corporate Communication Organization

Functions Controlled By:		Corp. Staff	Subsid. Staff	P & L Divs.	Geog. Divs.	Local Offices	Other
Voice-Network	62	1	2	3	4	5	6 ________
Voice-Equipment	63	1	2	3	4	5	6 ________
DataComm-Host	64	1	2	3	4	5	6 ________
DataComm-Network	65	1	2	3	4	5	6 ________
DataComm-Equipment	66	1	2	3	4	5	6 ________
Message-Network	67	1	2	3	4	5	6 ________
Message-Equipment	68	1	2	3	4	5	6 ________
Fax-Network/Services	69	1	2	3	4	5	6 ________
Fax-Equipment	70	1	2	3	4	5	6 ________
Office Equip. W/Comm.							
- Equipment	71	1	2	3	4	5	6 ________
- Network	72	1	2	3	4	5	6 ________
International Nets	73	1	2	3	4	5	6 ________

VOICE NETWORK

Corporate-wide or multiple voice networks?

(X) Network description ______________________________

	Location	Equipment	Number of Lines	Traffic Volume
(X) Major Switching Centers	74________	75________	76________	77________
	78________	79________	80________	81________
	82________	83________	84________	85________
	86 more			

	Number of Circuits	From	To	Carrier	Type (Sat, Terr, Spcl)
Size of Major Trunk Groups	87____	88________	89________	90____	91____
	92____	93________	94________	95____	96____
	97____	98________	99________	100____	101____
	102____	103________	104________	105____	106____
	107 more				
Int'l Voice Ckts.	108____	109________	110________	111____	112____
	113 more				

# of PBX/Centrex Locations 114____

Any Offices without PBX or Keysets? 114A____ How Many? 114B____

	Manufacturer	Model	Quantity	Average # Of Lines
PBX Equipment	115 ____	116 ____	117 ____	118 ____
	119 ____	120 ____	121 ____	122 ____
	123 ____	124 ____	125 ____	126 ____
	127 ____	128 ____	129 ____	130 ____
	131 ____	132 ____	133 ____	134 ____

VOICE NETWORK - (continued)

MAJOR APPLICATION

Number of Off-Net Facilities	Number	Major Application
WATS-In	135_____	__________ 136_____
WATS-Out	137_____	__________ 138_____
FX	139_____	__________ 140_____
RCF	141_____	__________ 142_____
OCC (SPRINT, etc.)	143_____	__________ 144_____
Other	145_____	__________ 146_____

Grade of Service - 147_________Planned 148_________Achieved

(X) Economics - Cost Per Minute - 149_________Intra-Company
150_________Off Net

Cost Billed To Users? 151_________

Access Control of Off-Net Facilities? 152_____ 153_____LCR? 154_____SMDR? 155_________ (Other)

(X) Network Growth Rate: 156_____$ 158_____Stations
157_____Traffic 159_____Miles

Relationship between voice growth rate and corporate growth rate 160_________

Recent significant changes?

(X) Planned significant changes?

Desired improvements?

DATA NETWORKS

(X) Number of Networks 161_____

Network	A	B	C	D	E	F
User Div./Dept.	162_____	163_____	164_____	165_____	166_____	167_____
(X) Number of Stations	168_____	169_____	170_____	171_____	172_____	173_____
Number of International Stations	174_____	175_____	176_____	177_____	178_____	179_____
Number of Terminals	180_____	181_____	182_____	183_____	184_____	185_____
Number of Remote Terminals	186_____	187_____	188_____	189_____	190_____	191_____
(X) Terminal Types	192_____	193_____	194_____	195_____	196_____	197_____
Line Speed	198_____	199_____	200_____	201_____	202_____	203_____
Line Type (DDD, Multi-pt, etc.)	204_____	205_____	206_____	207_____	208_____	209_____
Host Computer Location	210_____	211_____	212_____	213_____	214_____	215_____
Host Computer Model	216_____	217_____	218_____	219_____	220_____	221_____
Front End Model	222_____	223_____	224_____	225_____	226_____	227_____
Front End Program	228_____	229_____	230_____	231_____	232_____	233_____
Programmed By	234_____	235_____	236_____	237_____	238_____	239_____
Access Method Used	240_____	241_____	242_____	243_____	244_____	245_____
(X) Network Configuration	246_____	247_____	248_____	249_____	250_____	251_____
Data Link Control	252_____	253_____	254_____	255_____	256_____	257_____
Network Age	258_____	259_____	260_____	261_____	262_____	263_____
Recent Major Changes	_____	_____	_____	_____	_____	_____

DATA NETWORKS - (continued)

Network	A	B	C	D	E	F
Traffic Volume	264_____	265_____	266_____	267_____	268_____	269_____
Growth Rate-Volume	270_____	271_____	272_____	273_____	274_____	275_____
Growth Rate-Stations	276_____	277_____	278_____	279_____	280_____	281_____
Host Application Program	282_____	283_____	284_____	285_____	286_____	287_____

(X) Primary User Application I__________________

I__________________

I__________________

I__________________

I__________________

I__________________

Communication Mode (Interactive, Batch)	288_____	289_____	290_____	291_____	292_____	293_____
Customersor Suppliers Connected	294_____	295_____	296_____	297_____	298_____	299_____

New Applications Expected?

(X) Planned Significant Changes?

(X) Any Merging of Networks Anticipated?

Any Use of Digital Transmission Services?

DATA NETWORKS - (continued)

Any Use of Packet Switching Services?

Any Use of Time Sharing Vendors Networks For Users' Communication Applications?

(X) What Changes Are Likely In The Terminals Installed?

- Quantity

- Level of Intelligence

CATALOG NO. X C O M _ _ _

DATA PROCESSING SYSTEMS

(X) Number of Data Processing Centers 300_____ (Includes International)

Data Processing Center	A	B	C	D
Location	301________	302________	303________	304________
Equipment	305________	306________	307________	308________
User Div./Dept.	________	________	________	________
Number of Communication lines	309________	310________	311________	312________
Size of Center Staff-Total	313________	314________	315________	316________
Size of Center Staff-Programmers	317________	318________	319________	320________
Size of Center Staff-Communications Personnel	321________	322________	323________	324________
Number of Major Mainframes	325________	326________	327________	328________

Number of Major Mainframes In Other Centers 329_________

How Much Vendor Provided Time Sharing?

- $ 330_____
- Terminals 331_____

(X) Is Time Sharing Used For Many Operational (Versus Analytical) Applications? 332_____

Is Time Sharing used with communications as an important element? 333_____

Recent significant changes?

(X) Planned Significant Changes?

Improvements Needed?

CATALOG NO. X C O M

MESSAGE NETWORK

	TELEX	TWX	DATAPHONE	PWS	OTHER	(WHICH?)
(X) Number of Networks	334___	335___	336___	337___	338___	___
Speed, Type	X	X	340___	341___	342___	___
(X) Number of Stations	343___	344___	345___	346___	347___	___
Types of Terminals	348___	349___	350___	351___	352___	___
Provided by	353___	354___	355___	356___	357___	___
Message Switcher Location (If Any)	358___	359___	360___	361___	362___	___
Message Switcher Type	363___	364___	365___	366___	367___	___
(X) Major Application	I___	I___	I___	I___	I___	
% International	368___	369___	370___	371___	372___	___
Traffic Pattern	I___	I___	I___	I___	I___	
Traffic Volume	373___	374___	375___	376___	377___	
Message Length	378___	379___	380___	381___	382___	
% Intra-Company	383___	384___	385___	386___	387___	
Urgency	388___	389___	390___	391___	392___	
Network Growth Rate	393___	394___	395___	396___	397___	

Applications Being Converted To Data Networks? 398___

Word Processors Connected? 399___

(X) Plans For Change?

Improvements Needed?

- Services

- Terminals

FAX NETWORKS

(X) Number of Networks 400_____

Networks	A	B	C	D
User Div./Dept.	_____	_____	_____	_____
(X) Number of Stations	401_____	402_____	403_____	404_____
(X) Terminal Types	405_____	406_____	407_____	408_____
Operating Speed	409_____	410_____	411_____	412_____
Line type	413_____	414_____	415_____	416_____
Control Center	417_____	418_____	419_____	420_____
Traffic Volume	421_____	422_____	423_____	424_____
Growth Rate-Volume	425_____	426_____	427_____	428_____
Growth Rate-Stations	429_____	430_____	431_____	432_____
(X) Primary User Application	I_______________	I_______________	I_______________	I_______________
Terminals at Work Stations, Convenience Stations, or Communication Centers?	433_____	434_____	435_____	436_____
Communication Method Replaced?	437_____	438_____	439_____	440_____

Any Use of Value Added Services? 441_____

New Applications Expected?

Any Use of Special Product Features E.G. Autodial, Unattended Operation, etc.

(X) Planned Significant Changes?

Plans to Use Digital Fax?

Desired Improvements?

SPECIAL NETWORK CAPABILITIES

			NOW USING	PLAN-NING	CONSI-DERING	NOT CONSI-DERING	NOT AWARE	REJECTED
(X)	Computerized PBX	442	1	2	3	4	5	6
(X)	- For NonVoice	443	1	2	3	4	5	6
	Display/Intelligence Telephones	444	1	2	3	4	5	6
(X)	Voice S/F Systems	445	1	2	3	4	5	6
	Voice Recognition Systems	446	1	2	3	4	5	6
	Combined Voice/Data Data Trunks	447	1	2	3	4	5	6
	Combined Voice/Data Modems	448	1	2	3	4	5	6
	Combined Voice/Data ModemPhones	449	1	2	3	4	5	6
	Packet Switched Networks							
	- Vendor Provided	450	1	2	3	4	5	6
(X)	- Private Systems	451	1	2	3	4	5	6
	T/S Computer Network							
	- Vendor Provided	452	1	2	3	4	5	6
	- Private Systems	453	1	2	3	4	5	6
	Electronic Mail Network							
	- Vendor Provided	454	1	2	3	4	5	6
	- Private Systems	455	1	2	3	4	5	6
	Communicating Word Processors	456	1	2	3	4	5	6
	Combined Word/ Data Processing	457	1	2	3	4	5	6
	Viewdata/Qube/ Etc. Systems	458	1	2	3	4	5	6
(X)	Wideband Intrabuilding Nets	459	1	2	3	4	5	6
	Private Earth Stations	460	1	2	3	4	5	6
(X)	Video Conferencing	461	1	2	3	4	5	6

SPECIAL NETWORK CAPABILITIES - (continued)

		NOW USING	PLAN-NING	CONSI-DERING	NOT CONSI-DERING	NOT AWARE	REJECTED
Other Teleconferencing	462	1	2	3	4	5	6
One Second Facsimile	463	1	2	3	4	5	6
Interfaces With							
- Customers' D.P. Systems	464	1	2	3	4	5	6
- Suppliers' D.P. Systems	465	1	2	3	4	5	6
High-Speed Data Transfers	466	1	2	3	4	5	6
Private Transmission Facilities	466A	1	2	3	4	5	6

POSSIBLE TRENDS

		INCREASING	DECREASING	NOT APPARENT
(X) Combination				
- Multiple Data Networks	467	1	2	3
- Voice and Data Networks	468	1	2	3
- Message and Data Networks	469	1	2	3
(X) Direct Telecommunications From				
- Employee Work Stations	470	1	2	3
- Suppliers/Customers	471	1	2	3
(X) Users Becoming More				
- Involved	472	1	2	3
- Knowledgeable	473	1	2	3
- Autonomous	474	1	2	3
Reliability of				
- Network Services	475	1	2	3
- Communication Equipment	476	1	2	3

POSSIBLE TRENDS - (continued)

		INCREASING	DECREASING	NOT APPARENT
Level of Vendor Support	477	1	2	3
(X) Use of Standard Network Architectures				
- Access Methods	478	1	2	3
- SNA, DecNet, DCA, etc.	479	1	2	3
- X.25, Etc.	480	1	2	3
Outright Purchase of				
- Terminals	481	1	2	3
- PBX	482	1	2	3
- Message Switchers	483	1	2	3
- DataComm Equipment	484	1	2	3
Maintenance Quality of				
- AT&T	485	1	2	3
- Other Suppliers	486	1	2	3

POTENTIAL PROBLEM AREAS

How Does Your Organization Handle:

Network Monitoring?

(X) Network Diagnostics?

Network Equipment Maintenance?

(X) Network Traffic Analysis?

Communications Programming

(X) - Intelligent (Programmable) Terminals

- Communication Mode Equipment?

- Message Switchers?

- Host Front Ends?

Use of Value Added Functions

- User Availability?

- User Training?

User Selection of Station Equipment?

Use of Acoustic Coupled Devices On Voice Network?

(X) Purchasing Process

- Development of Specs

- Matching of Specs

- Acceptance Criteria/Evaluation

Selection Criteria Between

- Telco Versus Interconnect

- Telco Versus VAN/SCC